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US Army Corps of Engineers

POMPTON DAM SPILLWAY, POMPTON LAKE RAMAPO RIVER BASIN, NEW JERSEY

Hydraulic Model Investigation

by

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A 1:25-scale model simulated two 35-ft-wide by 18-ft-high tainter gates with a 19-ft radius, three 6-ft-wide piers, a 5.27-ft-long apron, a schematic of the pumping station and fore-bay intakes on the right, the existing log boom posts upstream of the fore-bay intakes, the turnpike bridge, the remaining 160-ft-long section of the existing fixed ogee spillway on the left and a 38-ft-long section of the existing fixed ogee spillway on the right of the proposed structure, 300 ft of the upstream approach, and 600 ft of the exit channel including a section of the channel extending 100 ft downstream of the turnpike bridge. Discharge characteristics and coefficients with various operating scenarios were determined. Flow patterns and velocities measured in the model indicated that the approach flow conditions were satisfactory, while some modification of the energy dissipator was necessary to spread the flow exiting the structure. Preconstruction conditions were compared with conditions that developed from the proposed structure. Scour potential was also determined downstream of the structure. Fish and aquatic habitation criteria for velocities were met.

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PREFACE

The model investigation reported herein was authorized by Headquarters, US Army Corps of Engineers, on 4 April 1989 at the request of the US Army Engineer District, New York.

The studies were conducted in the Hydraulics Laboratory (HL), US Army Engineer Waterways Experiment Station (WES), during the period April 1989 to November 1990 under the direction of Messrs. F. A. Herrmann, Jr., Chief, and G. Pickering, Chief, Hydraulic Structures Division. The tests were conducted by Mrs. Deborah R. Cooper, Messrs. E. L. Jefferson and R. Bryant, Jr., Spillways and Channels Branch, under the direct supervision of Mr. N. R. Oswalt, Chief, Spillways and Channels Branch. This report was prepared by Mrs. Cooper.

During the course of the investigation Messrs. R. Schembri, P. Sylvestre, P. Tuminello, and J. Rosen, New York District, visited WES to discuss test results and correlate these results with current design studies.

Mr. Melvin Bolden constructed the model.

COL Larry B. Fulton, EN, is the Commander and Director of WES. Dr. Robert W. Whalin is the Technical Director.

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CONVERSION FACTORS, NON-SI TO SI (METRIC)
UNITS OF MEASUREMENT

Non-SI units of mᵉasurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
acres	4,046.873	square meters
acres-feet	1,233.489	cubic meters
cubic feet per second	0.02831685	cubic meters per second
degrees (angular)	0.01745329	radians
feet	0.3048	meters
feet per second	0.3048	meters per second
gallons (US liquid) per day	0.00000004381264	cubic meters per second
inches	25.4	millimeters
miles (US statute)	1.609344	kilometers

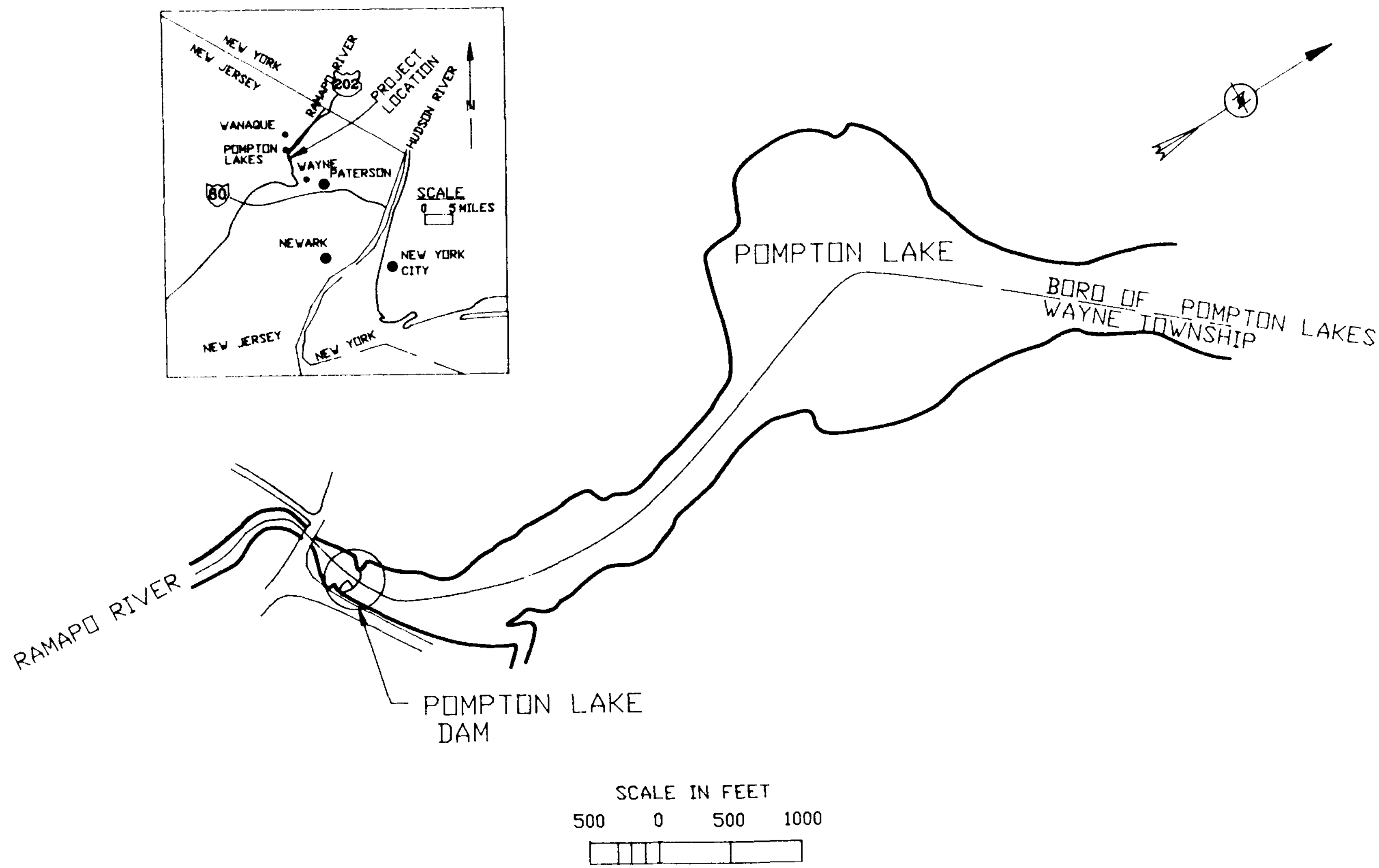

Figure 1. Location map

POMPTON DAM SPILLWAY, POMPTON LAKE, RAMAPO RIVER BASIN, NEW JERSEY

Hydraulic Model Investigation

PART I: INTRODUCTION

The Prototype

1. Pompton Lake Dam is located on the Ramapo River in Wayne and Pompton Lakes, New Jersey (Figure 1), creating a lake 1.6 miles* long with a surface area of 205 acres and storage volume of 1,100 acre-ft at the spillway. The drainage area of 160 square miles is about 35 miles long and an average of 4.5 miles wide and is located in the states of New York and New Jersey. The dam is owned by the North Jersey District Water Supply Commission and is used to create a pool for a run-of-the-river pumping station, which is utilized in an intermittent operational mode for water supply. The station has a capacity of 100 million gallons per day (mgd) which is currently being increased to 150 mgd (233 cfs) for pumping water into the Wanaque Reservoir located 4 miles to the north and 100 ft higher in elevation. Recreation is an important secondary use which is represented by park sites developed adjacent to the lake. The Pompton Lake Dam is basically a concrete gravity spillway, although it combines features of an arched structure (Plate 1). The spillway section is approximately 290 ft long. It has a maximum height of 30 ft and is shaped by compound circular curves to create an ogee section. On the east end, the spillway is tied into a massive basalt outcrop, which is now covered by the embankment of US Route 202. The west end of the spillway is tied into a wing wall of a pump station intake and retaining walls which are keyed into high ground and bedrock. The existing dam is at el 201.0**

2. To alleviate flooding in residential areas upstream of Pompton Lake in the Borough of Oakland, New Jersey, an 88-ft-wide section of the existing fixed ogee spillway will be replaced by a gated spillway (el 185.0) with two

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* A table of factors for converting Non-SI units of measurement to SI (metric) units of measurement is presented on page 3.

** All elevations (el) and stages cited herein are in feet referred to the National Geodetic Vertical Datum (NGVD).

35-ft-wide by 18-ft-high tainter gates and three 6-ft-wide concrete piers terminated by a 5.27-ft-long horizontal apron.

Purpose and Scope of the Model Study

3. This model study was conducted to determine the spillway discharge capacity and observe and define flow conditions upstream and downstream of the dam to ensure that undesirable conditions did not develop as a result of the proposed dam modification. In addition, energy dissipation downstream of the spillway through the full range of operation and determination of the extent of scour were of interest. Discharge characteristics and coefficients with various operating scenarios were determined from the model.

Presentation of Data

4. In the presentation of test results, no attempt is made to introduce the data in the chronological order in which the tests were conducted on the model. Instead, as each element of the structure is considered, all tests conducted thereon are discussed in detail. All model data are presented in terms of prototype equivalents. All tests are discussed in Part III.

PART II: THE MODEL AND TEST PROCEDURE

Description

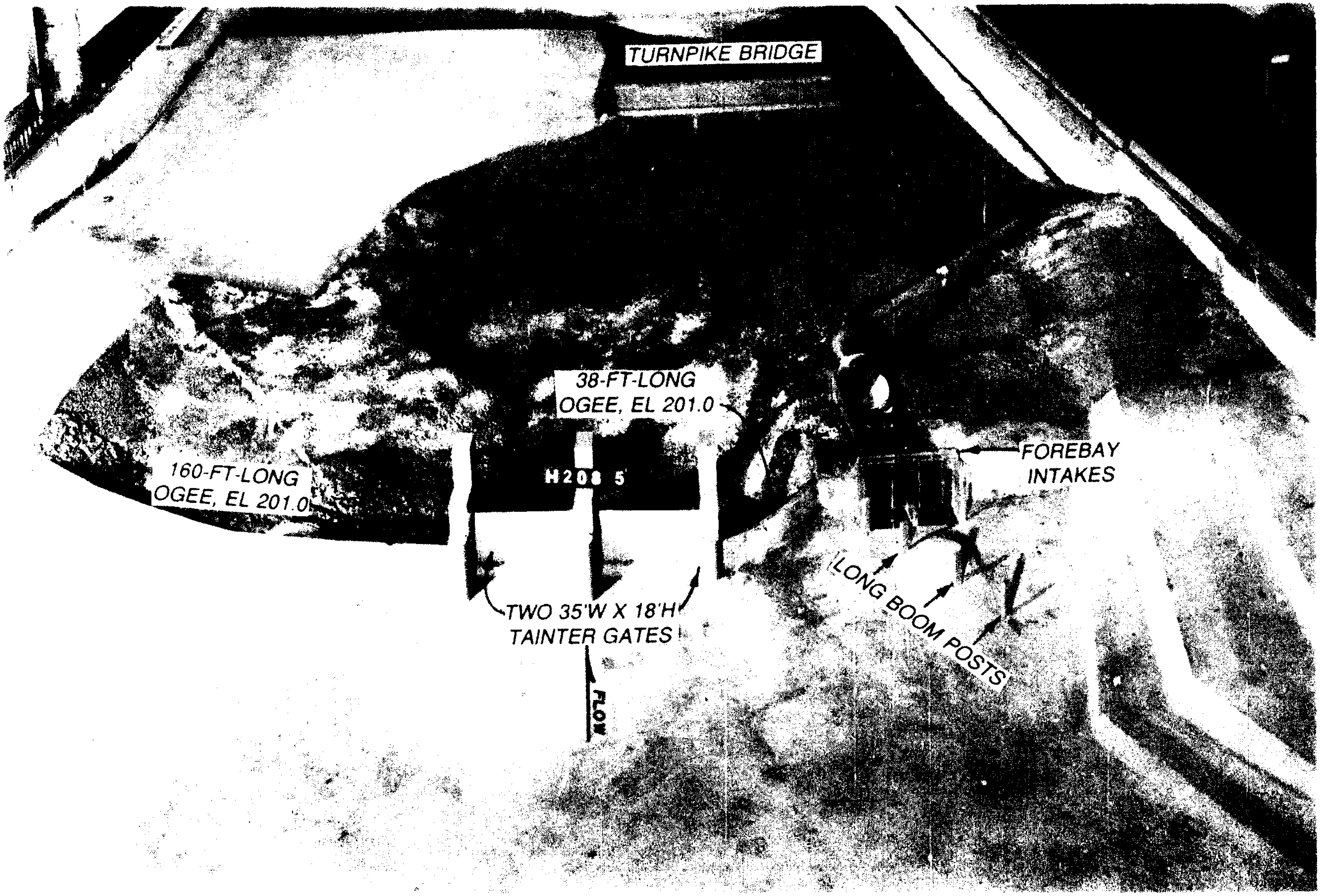
5. A 1:25-scale model (Figure 2, Plate 2) reproduced two 35-ft-wide by 18-ft-high tainter gates with a 19-ft radius, three 6-ft-wide piers, a 5.27-ft-long apron, a schematic of the pumping station and fore-bay intakes on the right, the existing log boom posts upstream of the fore-bay intakes, the turnpike bridge, the remaining 160-ft-long section of the existing fixed ogee spillway on the left and a 38-ft-long section of the existing fixed ogee spillway on the right of the proposed structure, 300 ft of the upstream approach, and 600 ft of the exit channel including a section of the channel extending 100 ft downstream of the turnpike bridge. The proposed model spillway, model tainter gates, piers, and the apron were constructed of sheet metal; the powerhouse and log boom posts were constructed of plywood; and the turnpike bridge and fore-bay intakes were constructed of plastic. The portions of the model representing the approach channel and the existing fixed ogee spillway were molded in concrete to sheet metal templates and were given a brush finish. The portions of the model representing the exit channel were molded in pea gravel and grouted with a fine dusting of cement. Screens and rubberized horsehair were placed in the model to simulate vegetation on the banks.

Appurtenances and Instrumentation

6. Water used in the operation of the model was supplied by pumps, and discharges were measured with venturi meters. The tailwater in the downstream end of the model was controlled by an adjustable tailgate. Steel rails set to grade provided reference planes. Water-surface elevations were obtained with point gages. Velocities were measured with an electromagnetic velocity meter, and contour elevations were measured using a sounding rod.

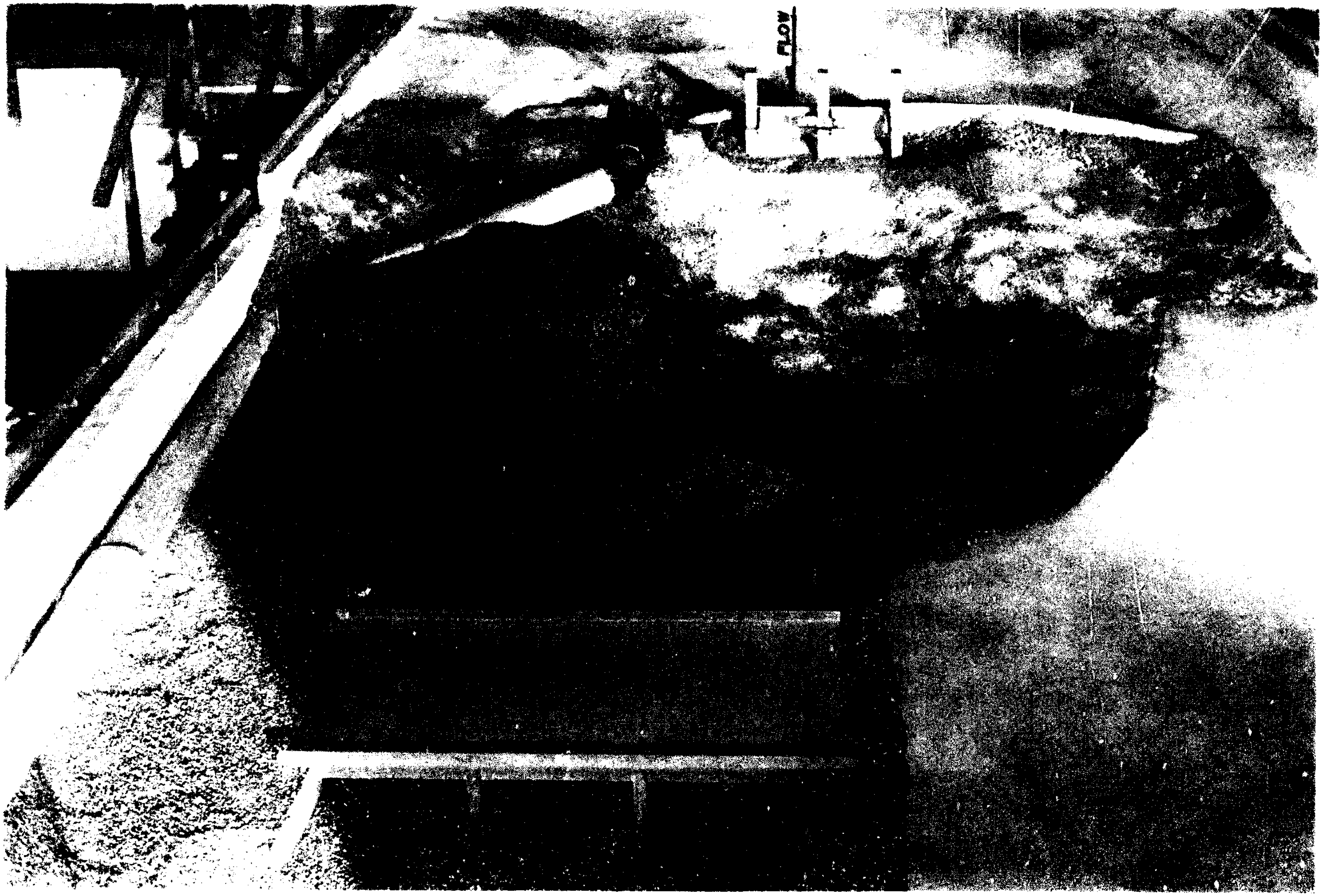
Scale Relations

7. The accepted equations of similitude, based upon the Froudian relations, were used to express the mathematical relations between the dimensions



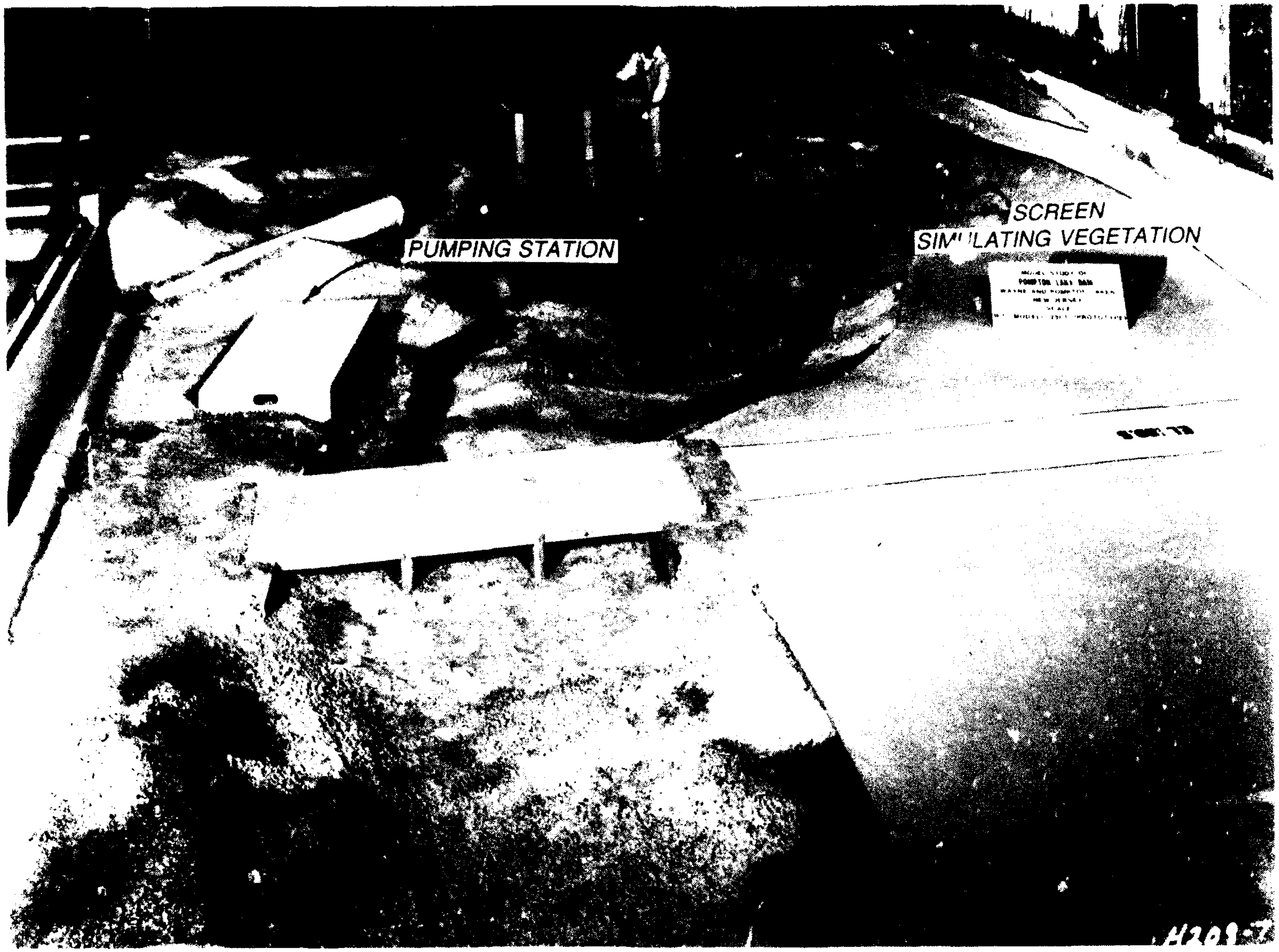
a. Looking downstream

Figure 2. Type 1 (original) design (Sheet 1 of 3)



b. Looking upstream

Figure 2. (Sheet 2 of 3)



c. Overall view, looking upstream

Figure 2. (Sheet 3 of 3)

and hydraulic quantities of the model and the prototype. General relations for the transference of model data to prototype equivalents are presented in the following tabulation:

Dimension	Ratio	Scale Relation
Length	$L_r = L$	1:25
Area	$A_r = L_r^2$	1:625
Velocity	$V_r = L_r^{1/2}$	1:5
Discharge	$Q_r = L_r^{5/2}$	1:3,125
Time	$T_r = L_r^{1/2}$	1:5

8. Quantitative measurements of discharge, water-surface elevation, time, and velocity in the model were converted to prototype dimensions by means of these scale relations.

PART III: TESTS AND RESULTS

Spillway Discharge Characteristics

9. Tests were conducted to determine the discharge characteristics for flow through the proposed gated spillway and flow over the existing spillway crest. Discharge rating curves for flow through both spillway bays, with flow over the existing spillway after the pool elevation reaches el 201.0, are shown in Plate 3. These curves were obtained by introducing various constant discharges into the model and observing the corresponding upper pool elevation after the pool was allowed to stabilize. This procedure was repeated for various gate openings as well as uncontrolled flow. The pool elevation was measured 50 ft upstream from the proposed spillway crest center line. The basic data used to construct these curves are tabulated in Table 1.

10. The relation between gross head on the proposed spillway and discharge through both gate bays is shown by the plot in Plate 4. This plot can be used to determine the amount of flow passing through the proposed spillway only.

11. Tests were conducted with flow through one gate and over the existing fixed ogee spillway sections to determine the discharge characteristics for single-gate operation, should this become necessary in the prototype structure. The left gate was sealed off and the right gate was operated to develop the basic discharge calibration curves shown in Plate 5. The data are tabulated in Table 1. When the pool reached el 203.0 (top of closed gate), flow overtopped the gate. As expected, controlled flow through a single gate was about one-half the controlled flow with both gates. With uncontrolled flow (gate fully opened), flow through a single gate was slightly less than one-half that of both gates, since there was more flow contraction per unit width of opening with the single gate. However, this was so small that it was negligible.

Stilling Basin

Type 1 (original) design

12. The original stilling basin (Plate 6) consisted of a 5.27-ft-long horizontal apron at el 180.0.

13. Velocities and water-surface elevations were measured in the approach and exit channels with the type 1 (original) design. These data were taken with the minimum tailwater elevations obtained in the model (MIN_mTW), the maximum expected tailwater elevations (MAX_mTW) for the 40-year flood (16,000 cfs), the 100-year flood (21,500 cfs), and the Standard Project Flood (SPF) (38,500 cfs). The value of MIN_mTW was greater than the minimum expected tailwater elevations in the tailwater rating curves provided by the US Army Engineer District, New York, as shown in Plate 7. This was due to the fact that the tailwater rating curves provided by the New York District were with the improved Passaic River Mainstem Project conditions which involve a lower channel bottom elevation under the turnpike bridge that was not modeled. The bridge controlled the tailwater in the model. Should the Passaic River mainstem project be authorized and the channel bottom under the bridge be lowered, tests will be conducted later with the improved conditions. Flow patterns and velocities at the surface, at middepth, and 1 ft above the channel floor are shown in Plates 8-10. Water-surface data are plotted in plan in Plates 11-13. A water-surface profile along the center line of the channel is shown in Plate 14. The basic water-surface elevation data are tabulated in Table 2. Velocities measured with the maximum tailwater from the New York District tailwater rating curves are shown in Plates 15-17. Water-surface data are plotted in Plates 18-20. Water-surface profiles along the center line of the channel are shown in Plate 21. Water-surface data are tabulated in Table 3.

14. Stop logs were then installed in the bulkhead slots in the model piers to approximate preconstruction conditions (the existing ogee spillway without the proposed structure). The stop log height was varied to allow the correct amount of flow over the top to compensate for flow blocked by the proposed structure (piers). Velocities and water-surface elevations were measured in the approach and exit channels with the "existing conditions," MIN_mTW, the maximum tailwater elevations for the 40- and 100-year floods, and the SPF. Flow patterns and velocities at the surface, at middepth and 1 ft above the channel floor measured with MIN_mTW are shown in Plates 22-24. Water-surface data are plotted in plan in Plates 25-27. A water-surface profile along the center line of the channel is shown in Plate 28. The basic water-surface elevation data are tabulated in Table 4. Velocities measured with the maximum tailwater are shown in Plates 29-31. Water-surface data are plotted in Plates 32-34. Water-surface profiles along the center line of the

channel with all three discharges and maximum tailwater are shown in Plate 35. The basic water-surface elevation data are tabulated in Table 5.

15. As could be expected, the proposed spillway caused flow to concentrate along the center of the channel. This caused eddies to form along the banks of the channel, particularly along the left side where the bank expands outward from the main channel (station (Sta) 102+00 - 104+00). Flow conditions with and without the proposed structure operating are shown in Photos 1-6. The eddies can be seen in the photographs with the proposed structure operating (Photos 1-3) and detected from the velocity plots (Plates 8-10, 15-17). The velocities measured in the eddies were not any greater than velocities measured with the existing conditions; thus, the proposed structure should not have any adverse effects on this area. Obviously, velocities immediately downstream from the structure and along the center of the channel were higher with the proposed structure. However, velocities approaching the turnpike bridge were better distributed and were less along the left abutment with some flows. From the velocity measurements and observations of flow conditions in the model, it appears that the only adverse effect that construction of the proposed spillway would have would be the increase of velocities in the area immediately downstream from the structure. This will be discussed later.

16. Water-surface profiles were measured along the center line and left and right sides of each gate bay for the type 1 (original) design structure with the 40- and 100-year floods and the SPF. The data are presented graphically in Plates 36-38. The basic water-surface data are recorded in Table 6. These profiles can be used to determine the loading on the wall and to determine if the tainter gate trunnions are properly located. The trunnions became submerged at the SPF, as can be seen in Plate 38.

17. Because the proposed gated structure will be constructed on rock, the structure was designed without an energy dissipator and with a 5.27 ft-long apron at the end of the curved spillway (Plate 6). As discussed previously, velocities in this area were rather high. Engineers from the New York District and the US Army Engineer Waterways Experiment Station (WES) decided that if velocities and circulation patterns could be reduced by making somewhat minor changes to the design, good engineering practice would be affected. Thus, additional tests were conducted in an effort to reduce the velocities.

Alternate designs

18. One reason for the high velocities was the eddies that formed in the exit channel causing flow to concentrate. Tests were conducted with straight pier extensions of 6, 12, 18, and 30 ft and 30-ft pier extensions that flared 15 deg outward. This also extended the length of the apron. Observations of flow conditions in the model and spot velocity measurements indicated that, instead of spreading flow, the extensions caused flow at the toe of the spillway to ride up and submerge the gate trunnions.

19. It would not be practical or economical to build a conventional hydraulic jump-type energy dissipator for this structure because of the excessive rock excavation (and resulting structure height) that would be required to maintain a hydraulic jump in the basin. Therefore, several apron lengths, orientations, and baffle block and end sill configurations were tested in an attempt to spread flow and reduce velocities. The various modifications were evaluated based on visual observations and velocities measured at Sta 103+50. The types 1-9 design energy dissipators are shown in Plates 39-47 along with the corresponding velocities measured with each design at the SPF. From these tests it appeared that the type 5 design with the 12-ft-long apron extension and 2-ft-high end sill (Figure 3) spread flow better than the other designs. Velocities and water-surface elevations were measured throughout the exit channel with the 40-year flow and the SPF for comparison with the original design. These velocities are shown in Plates 48 and 49. Water-surface elevations and profiles are shown in Plates 50-52. The data are tabulated in Table 7. Comparison of the velocity measurements with the types 1 and 5 designs showed that there was little overall improvement of energy dissipation with the type 5 design. Because of the channel configuration downstream, WES concluded that major modifications to the structure would be required to improve flow conditions. The type 1 design structure was recommended for construction in the prototype.

Scour Potential

20. The fixed model bed in the exit channel was modified to a moveable bed by removing the grouted pea gravel crust and using the exposed pea gravel that simulated prototype rock sizes up to 6 in. in diameter. Areas simulating bedrock strata were grouted with a fine dusting of cement. The bed was

Figure 3. Type 5 design, downstream view

remolded using contour maps and scour tests were conducted. Scour depths and locations were measured using a sounding rod for the 40-year flood and the SPF after 10 hr (prototype) of operation. These values are tabulated in Table 8 and plotted in Plates 53 and 54. The extent of scour is shown in Photos 7 and 8. The extent and depth of scour was greater with the 40-year flow than with the SPF, since the tailwater elevation was considerably lower and the jet from the spillway plunged through the tailwater and scoured the bed material. Based on the scour depths measured, scour potential near the turnpike bridge was not considered to be a problem. Results of these tests are qualitative in nature. The tests indicate areas of highest scour potential, but exact scour depths cannot be predicted in a model with material of this type.

Approach Velocities

21. At the request of the New York District, velocities in the approach were measured for a 1-ft gate opening and a 201.5 pool elevation. Surface, middepth, and bottom velocities are shown in Plates 55-57. The data are tabulated in Table 9. The velocities did not exceed 2 fps, which is the limit set for fish and aquatic habitation in the New York District area.

PART IV: DISCUSSION AND CONCLUSIONS

22. Discharge rating curves were determined for flow through the proposed spillway structure with one or two gates operating with gate openings from 0 ft to fully open. When the elevation of the upper pool reached 201.0, flow spilled over the existing spillway crest and passed through the proposed structure. The rating curves can be used to maintain the desired upper pool elevation through proper operation of the spillway gates.

23. Obviously, velocities immediately downstream from the structure and along the center of the channel were higher with the proposed structure. However, velocities approaching the turnpike bridge were better distributed and were less along the left abutment with some flows. From the velocity measurements and observations of flow conditions in the model, it appears that the only adverse effect that construction of the proposed spillway would have would be the increase of velocities in the area immediately downstream from the structure. It would not be practical or economical to build a conventional hydraulic jump-type energy dissipator for this structure because of the excessive rock excavation (and resulting structure height) that would be required to maintain a hydraulic jump in the basin. Several apron lengths and orientations and baffle block and end sill configurations were tested in an attempt to spread flow and reduce velocities. Comparison of the velocity measurements with the types 1 (original) and 5 (12-ft-long apron extension with 2-ft-high endsill) designs showed that there was little overall improvement of energy dissipation with the type 5 design. Because of the channel configuration downstream, WES concluded that very little could be done to improve flow conditions without major modifications to the structure.

24. With the installation of the two tainter gates, the scour conditions downstream of the energy dissipator were determined to be more severe with the 40-year flood than with the SPF. Scour potential downstream of the dam near the bridge was not considered to be a problem.

25. Velocities measured upstream of the structure with a 1.0-ft gate opening and pool el 201.5 were less than 2.0 fps, which is a limit set for fish and aquatic habitation in the New York District area.

Table 1

Calibration Data For Gate Rating Curves

Two-Gate Operation			One-Gate Operation		
Gate Opening ft	Discharge, Q cfs	Pool el	Gate Opening ft	Discharge, Q cfs	Pool el
0	1,000	202.4	2	1,000	197.0
0	1,500	202.7	2	1,500	201.6
0	2,000	203.0	2	3,250	203.4
0	2,500	203.2	2	8,000	205.2
1	1,000	190.9	4	1,000	189.7
1	1,500	196.1	4	2,000	194.0
1	2,000	201.3	4	3,700	201.6
1	2,500	201.9	4	6,500	203.6
			4	10,500	204.9
2	1,000	188.8	6	2,500	194.8
2	1,500	191.8	6	3,500	200.0
2	2,000	193.7	6	9,600	205.0
2	2,500	197.7	6	13,900	206.0
2	3,500	201.0			
2	5,000	202.9			
2	10,000	205.2			
4	3,200	191.7	8	4,000	196.4
4	4,000	193.7	8	5,000	199.7
4	5,000	197.2	8	8,750	203.9
4	6,000	201.9	8	12,750	204.9
4	7,500	202.5	8	16,500	206.1
4	10,000	203.4			
4	15,000	205.2			
6	5,000	193.3	10	5,500	197.7
6	6,000	195.4	10	6,000	199.1
6	7,000	197.7	10	8,000	202.2
6	7,500	199.9	10	11,900	203.9
6	8,500	201.2	10	16,250	205.4
6	10,000	202.2			
6	15,000	204.1			
6	20,000	205.9			
8	9,000	197.8	UC	500	187.3
8	10,000	200.3	UC	3,000	193.0
8	15,000	203.3	UC	5,000	196.5
8	20,000	204.9	UC	7,500	200.8
8	25,000	206.3	UC	10,500	202.2
			UC	24,250	207.4
10	11,000	198.5			

(Continued)

Note: UC indicates uncontrolled flow.

Table 1 (Concluded)

Two-Gate Operation			One-Gate Operation		
Gate Opening ft	Discharge, Q cfs	Pool el	Gate Opening ft	Discharge, Q cfs	Pool el
10	12,000	200.7			
10	12,500	201.0			
10	13,000	201.5			
10	15,000	202.7			
10	20,000	204.0			
10	25,000	205.6			
10	30,000	207.2			
12	20,000	202.5			
12	30,000	206.1			
UC	2,500	190.0			
UC	3,800	191.4			
UC	5,000	192.7			
UC	7,500	195.2			
UC	10,000	197.3			
UC	12,000	198.5			
UC	15,000	200.4			
UC	20,000	202.2			
UC	25,000	203.6			
UC	30,000	205.2			
UC	33,000	206.2			
UC	38,500	207.4			

Table 2

Pompton Dam Water-Surface Elevation Data, Minimum Tailwater

Type 1 (Original) Design

Q = 16,000 cfs pool el 201.1 MIN$_m$ TW el 190.0		Q = 21,500 cfs pool el 202.9 MIN$_m$ TW el 192.0		Q = 38,500 cfs pool el 206.5 MIN$_m$ TW el 198.0	
Sta	WS El	Sta	WS El	Sta	WS El
107+25	201.9	107+50	203.2	107+50	207.3
106+25	201.9	106+50	203.4	106+50	207.2
105+33	195.0	105+75	203.1	105+33	198.8
105+28	194.6	105+33	196.8	105+28	198.1
105+23	193.5	105+28	195.5	105+23	197.2
105+18	192.0	105+23	194.9	105+18	196.3
105+13	190.2	105+18	193.3	105+13	196.0
105+07.5	189.2	105+13	191.8	105+07.5	195.4
104+50	186.2	105+07.5	190.4	104+50	196.6
104+00	188.6	104+50	188.6	103+50	196.8
103+50	188.8	103+50	190.9	102+50	198.2
103+00	189.8	102+50	191.8	101+50	199.2
102+50	190.4	101+50	193.0	101+00	199.2
102+00	191.1				
101+50	190.9				
101+00	191.4				

Table 3

Pompton Dam Water-Surface Elevation Data, Maximum Tailwater

Type 1 (Original) Design

Q = 16,000 cfs pool el 201.1 MAX_{m} TW el 192.5		Q = 21,500 cfs pool el 202.9 MAX_{m} TW el 194.5		Q = 38,500 cfs pool el 206.5 MAX_{m} TW el 199.0	
Sta	WS El	Sta	WS El	Sta	WS El
107+25	201.9	107+50	203.2	107+50	207.3
106+25	201.9	106+50	203.4	106+50	207.2
105+33	195.0	105+75	203.1	105+33	198.8
105+28	194.6	105+33	196.8	105+28	198.1
105+23	193.5	105+28	195.5	105+23	197.2
105+18	192.0	105+23	194.9	105+18	196.3
105+13	190.2	105+18	193.3	105+13	196.0
105+07.5	189.2	105+13	191.8	105+07.5	195.4
104+50	190.3	105+07.5	190.4	104+50	198.2
104+00	192.1	104+50	192.0	103+50	195.3
103+50	192.3	104+00	186.7	102+50	199.4
103+00	192.9	103+50	194.4	101+50	199.8
102+50	193.4	103+00	195.0	101+00	200.2
102+00	194.0	102+50	195.1		
101+50	194.6	102+00	195.7		
101+00	193.9	101+50	196.0		
		101+00	196.6		

Table 4

Pompton Dam Water-Surface Elevation Data, Minimum Tailwater

Existing Conditions

Q = 16,000 cfs pool el 205.8 MIN_m TW el 190.0		Q = 21,500 cfs pool el 206.5 MIN_m TW el 192.0		Q = 38,500 cfs pool el 209.0 MIN_m TW el 198.0	
Sta	WS El	Sta	WS El	Sta	WS El
107+25	206.6	107+50	207.4	107+50	210.1
106+25	206.8	106+50	207.4	106+50	210.0
104+50	190.4	104+50	192.0	104+50	196.7
103+50	190.0	103+50	192.4	103+50	197.8
102+50	191.0	102+50	193.8	102+50	199.0
101+50	190.2	101+50	192.8	101+50	198.6
101+00	189.4			101+00	198.4

Table 5

Pompton Dam Water-Surface Elevation Data, Maximum Tailwater

Existing Conditions

Q = 16,000 cfs pool el 205.8 MAX_m TW el 192.5		Q = 21,500 cfs pool el 206.5 MAX_m TW el 194.5		Q = 38,500 cfs pool el 209.0 MAX_m TW el 199.0	
Sta	WS El	Sta	WS El	Sta	WS El
107+25	206.6	107+50	207.4	107+50	210.1
106+25	206.8	106+50	207.4	106+50	210.0
104+50	191.8	104+50	194.0	104+50	197.4
103+50	192.8	103+50	194.6	103+50	198.1
102+50	193.6	102+50	196.0	102+50	199.6
102+00	193.2	101+50	195.7	101+50	199.0
101+50	192.8	101+00	194.8	101+00	199.3
101+00	191.9				

Table 6

Pompton Dam Water-Surface Profile Data

Type 1 (Original) Design

	Q = 16,000 cfs, pool el 201.1 TW el 192.5			Q = 21,500 cfs, pool el 202 5 TW el 194.5			Q = 38,500 cfs, pool el 206.5 TW el 199.0		
Sta	Right Abutment WS El	Gate Bay Center line WS El	Left Abutment WS El	Right Abutment WS El	Gate Bay Center line WS El	Left Abutment WS El	Right Abutment WS El	Gate Bay Center line WS El	Left Abutment WS El
				Left Gate Bay Looking Downstream					
105+33	195.0	195.7	191.4	196.8	197.5	191.6	198.8	201.3	195.5
105+28	194.6	194.3	192.5	195.5	195.5	192.8	198.1	199.1	195.0
105+23	193.5	192.5	192.7	194.9	194.9	193.3	197.2	197.0	194.0
105+18	192.0	190.4	191.6	193.3	192.0	193.0	196.3	195.4	194.4
105+13	190.2	188.5	191.4	191.8	190.0	192.9	196.0	193.5	196.0
105+07	189.2	187.8	190.3	190.4	189.2	192.1	195.4	192.4	196.7
				Right Gate Bay Looking Downstream					
105+33	190.6	196.1	195.6	190.6	198.0	197.2	194.1	200.5	200.6
105+28	192.0	194.5	195.1	192.3	196.0	196.0	192.8	199.1	199.4
105+23	193.6	192.8	193.8	192.3	194.[illegible]	195.1	192.6	197.3	198.3
105+18	192.9	190.7	192.1	193.3	192.2	193.6	192.5	195.8	197.3
105+13	191.2	188.6	190.3	192.6	190.3	192.0	194.1	194.0	195.9
105+07	190.2	188.0	189.2	191.9	189.4	190.7	195.5	192.6	195.8

Table 7

Pompton Dam Water-Surface Elevation Data

Type 5 Design

Sta	WS El
Discharge, Q = 16,000 cfs, pool el 201.1 TW el 192.5	
104+50	189.5
103+50	191.9
102+50	193.1
101+50	193.3
101+00	193.1
Discharge, Q = 38,500 cfs, pool el 206.5 TW el 199.0	
104+50	196.4
103+50	196.0
102+50	199.0
101+50	199.4
101+00	200.0

Table 8

Pompton Scour Data

Type 5 Design

Sta	Distance Left of Model ℄	Distance Right of Model ℄	Contour El
Discharge, Q = 16,000 cfs, Pool el 201.1, TW el 192.5, T = 10 hr			
103+75	–	25	149.5
	–	50	150.5
	–	75	151.5
	–	100	169.5
	25	–	158.0
	37.5	–	167.5
103+50	–	0	153.8
	–	25	153.0
	–	50	156.0
	–	75	171.5
	–	100	174.2
	25	–	161.5
	37.5	–	164.5
103+00	–	0	171.0
	–	25	174.3
	–	50	174.2
	–	75	173.5
	–	100	183.5
	25	–	167.0
	50	–	167.2
	62.5	–	171.5
102+50	–	0	163.5
	–	25	165.0
	–	50	168.0
	–	75	171.0
	–	100	177.5
	–	125	184.5
	25	–	163.5
	50	–	166.0
	62.5	–	170.0
102+00	–	0	168.5
	–	25	170.5
	–	50	173.0
	–	75	175.5
	–	100	177.5
	–	125	180.0
	25	–	170.3
	37.5	–	170.5
101+50	–	25	177.0
	–	50	177.7
	–	75	177.8
	–	100	180.0
	–	125	178.3
101+00	–	50	177.7
	–	75	177.0
	–	100	176.5
	–	125	178.0
	–	150	177.5
Discharge, Q = 38,500 cfs, Pool el 206.5, TW el 199.0, T = 10 hr			
103+75	–	0	160.0
	–	25	159.8
	–	50	162.5
	–	75	167.0
	–	100	174.8
	25	–	163.0
102+50	–	0	174.0
	–	25	172.5
	–	50	176.5
	–	75	172.5
	–	100	176.5
	–	125	185.5

(Continued)

Table 8 (Concluded)

Sta	Distance Left of Model ℄	Distance Right of Model ℄	Contour El	Sta	Distance Left of Model ℄	Distance Right of Model ℄	Contour El
Discharge, Q = 38,500 cfs, Pool el 206.5, TW el 199.0, T = 10 hr							
	37.5	–	168.0		25	–	163.5
	50	–	175.5		50	–	166.5
					62.5	–	171.5
103+50	–	0	160.5				
	–	25	160.5	102+00	–	0	170.5
	–	50	163.0		–	25	170.5
	–	75	168.0		–	50	172.5
	–	100	175.0		–	75	174.5
	25	–	162.0		–	100	177.5
	50	–	167.0		–	125	182.5
	75	–	173.0		25	–	170.0
					37.5	–	174.5
103+00	–	0	162.5	101+50	–	0	180.0
	–	25	160.0		–	25	177.5
	–	50	171.5		–	50	176.0
	–	75	179.5		–	75	177.5
	–	100	176.0		–	100	179.7
	–	125	184.5		–	125	178.7
	25	–	168.5		–	137.5	179.5
	50	–	161.5				
	75	–	167.5	101+00	–	50	175.5
					–	75	174.0
					–	100	174.5
					–	125	176.7
					–	137.5	177.5

Table 9

Pompton Velocities in Approach

Discharge, Q = 3,100 cfs Gate Opening = 1 ft	Pool el = 201.5	TW el = 181.5 Velocity Prototype fps
Sta 0+00		
Upstream of left abutment	Surface	1.1
	Middepth	1.1
	Bottom*	1.3
Left gate center line	Surface	0.9
	Middepth	1.0
	Bottom*	0.7
Right gate center line	Surface	1.0
	Middepth	1.2
	Bottom*	1.1
50 ft right of right gate	Surface	0.8
	Middepth	0.0
	Bottom*	0.0
Sta 0+25		
40 ft left of left gate center line	Surface	0.7
	Middepth	0.7
	Bottom*	0.5
Left gate center line	Surface	0.6
	Middepth	0.6
	Bottom*	0.5
Right gate center line	Surface	0.8
	Middepth	0.8
	Bottom*	0.6
40 ft right of right gate center line	Surface	0.5
	Middepth	0.6
	Bottom*	0.0
Sta 0+50		
50 ft left of left gate center line	Surface	0.2
	Middepth	0.5
	Bottom*	0.3
Left gate center line	Surface	0.6
	Middepth	0.5
	Bottom*	0.3

(Continued)

* 1 ft above reservoir floor

Table 9 (Concluded)

Discharge, Q = 3,100 cfs Gate Opening = 1 ft	Pool el = 201.5	TW el = 181.5 Velocity Prototype fps
Right gate center line	Surface	0.6
	Middepth	0.6
	Bottom*	0.5
50 ft right of right gate center line	Surface	0.8
	Middepth	1.0
	Bottom*	0.6
Sta 1+00		
100 ft left of left gate center line	Surface	0.0
	Middepth	0.0
	Bottom*	0.0
50 ft left of left center line	Surface	0.0
	Middepth	0.0
	Bottom*	0.0
Left gate center line	Surface	0.3
	Middepth	0.2
	Bottom*	0.0
Right centerline	Surface	0.4
	Middepth	0.3
	Bottom*	0.0
50 ft right of right gate center line	Surface	0.3
	Middepth	0.3
	Bottom*	0.2
100 ft right of right gate center line	Surface	0.8
	Middepth	0.7
	Bottom*	0.6

* 1 ft above reservoir floor

Photo 1. Type 1 (original) design. Q = 16,000 cfs, pool el 201.1, MIN_mTW el 190.0

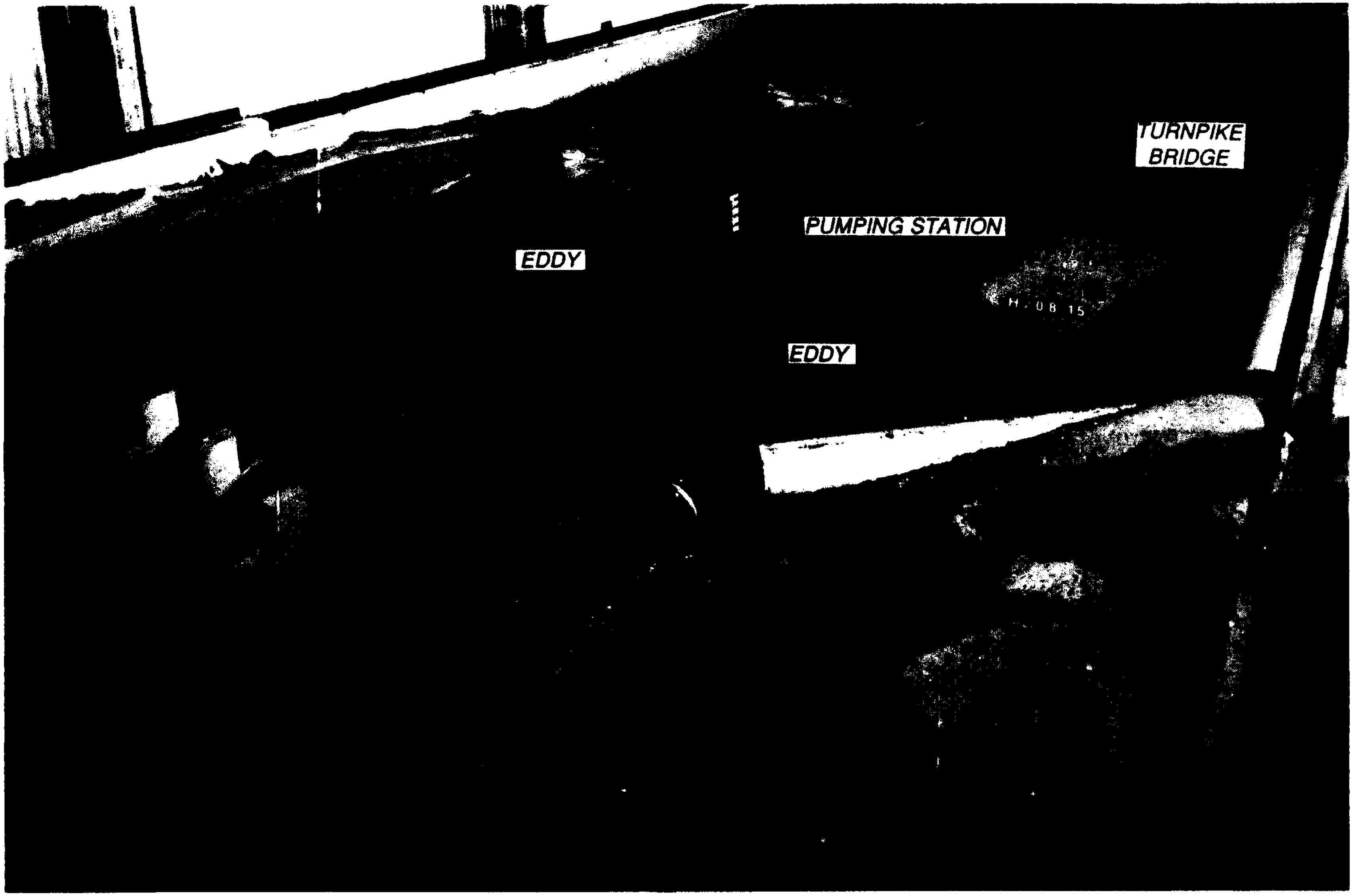


Photo 2. Type 1 (original) design, Q = 21,500 cfs, pool el 202.9, $MIN_m TW$ el 192.0

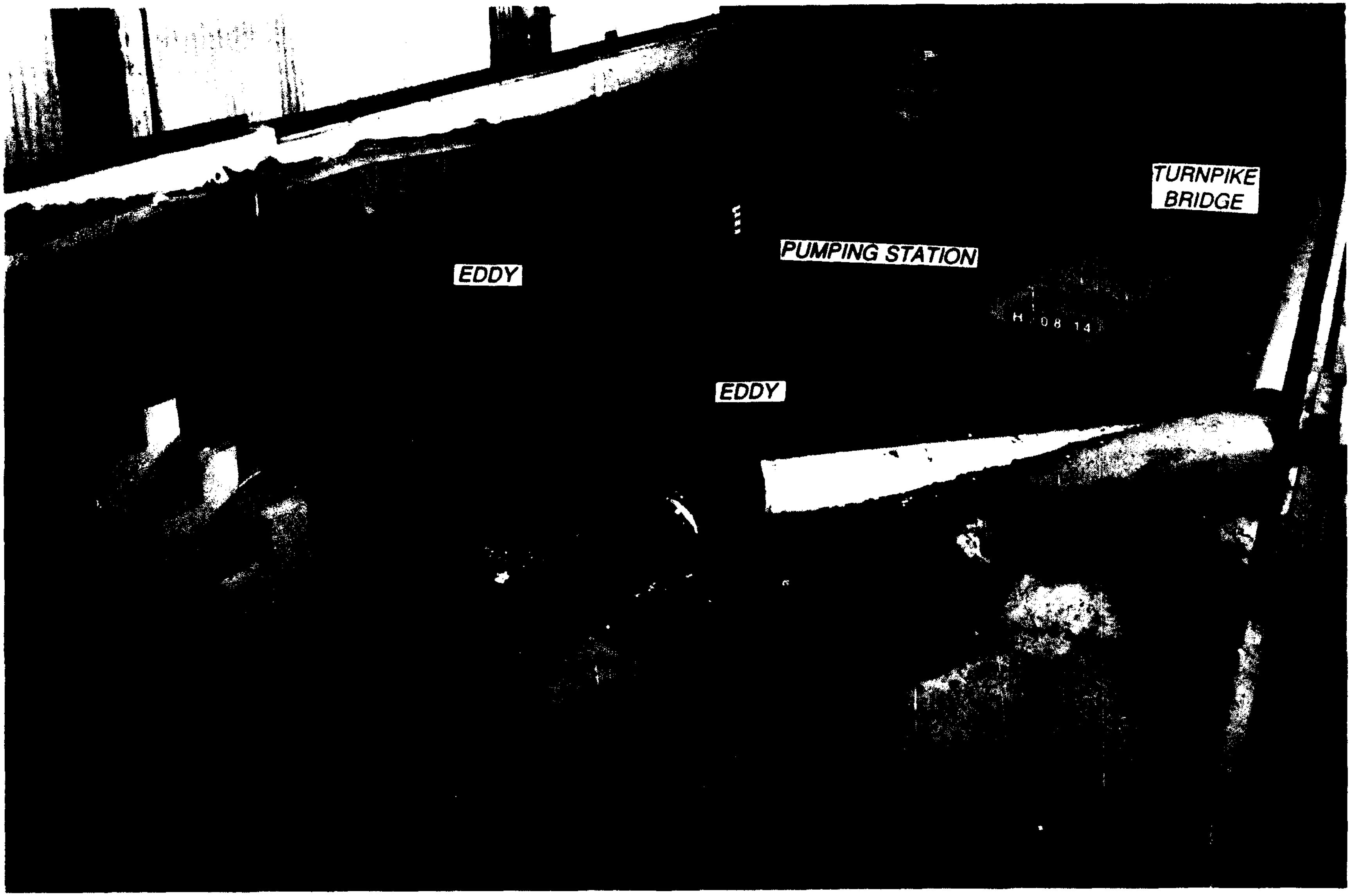


Photo 3. Type 1 (original) design, Q = 38,500 cfs, pool el 206.5, $MIN_{m}TW$ el 198.0

Photo 4. Simulated existing conditions, Q = 16,000 cfs, pool el 205.8, $MIN_m TW$ el 190.0

Photo 5. Simulated existing conditions, Q = 21,500 cfs, pool el 206.5, $MIN_m TW$ el 192.0

Photo 6. Simulated existing conditions, $Q = 38,500$ cfs, pool el 209.0, $MIN_m TW$ el 198.0

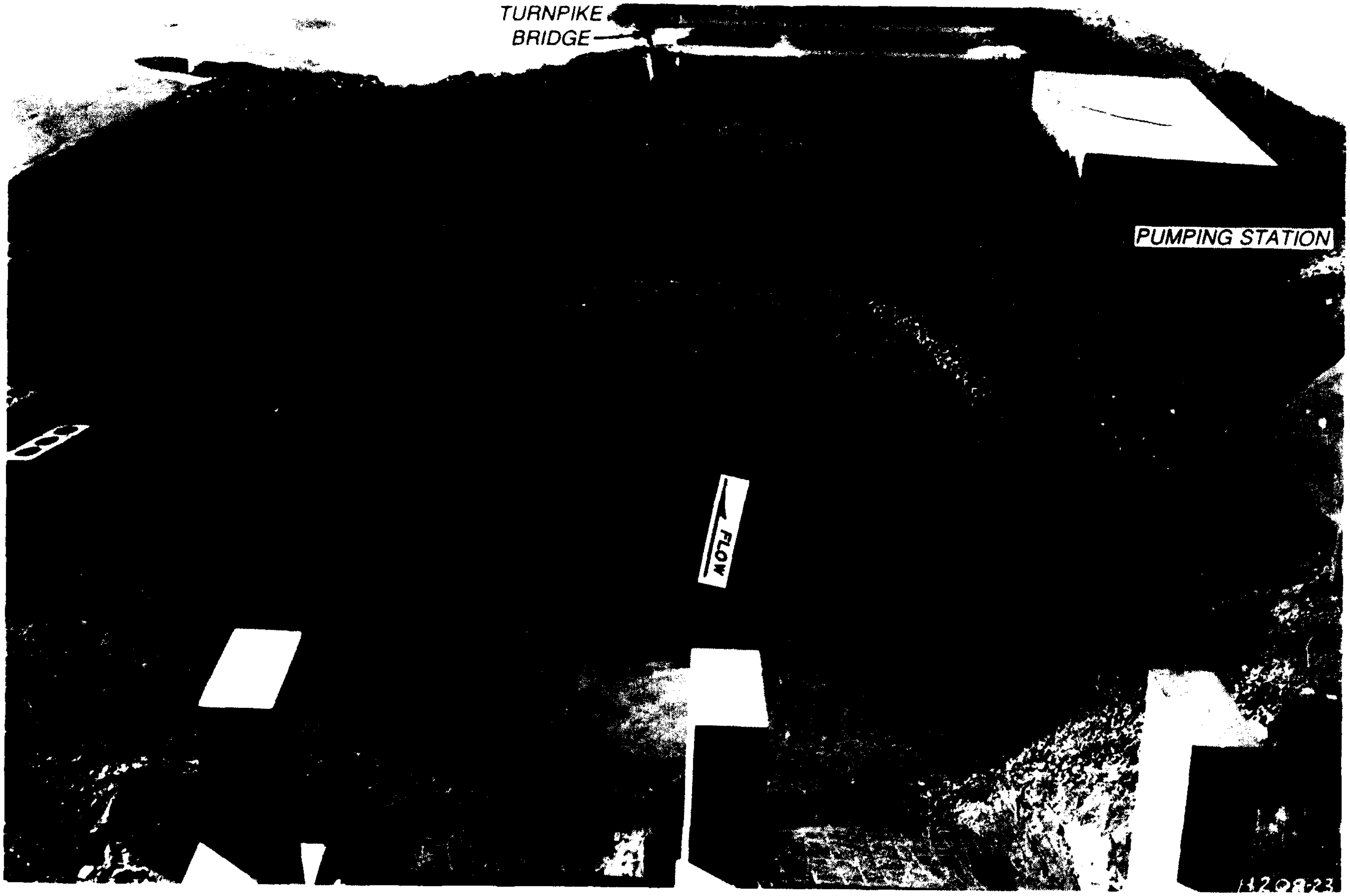
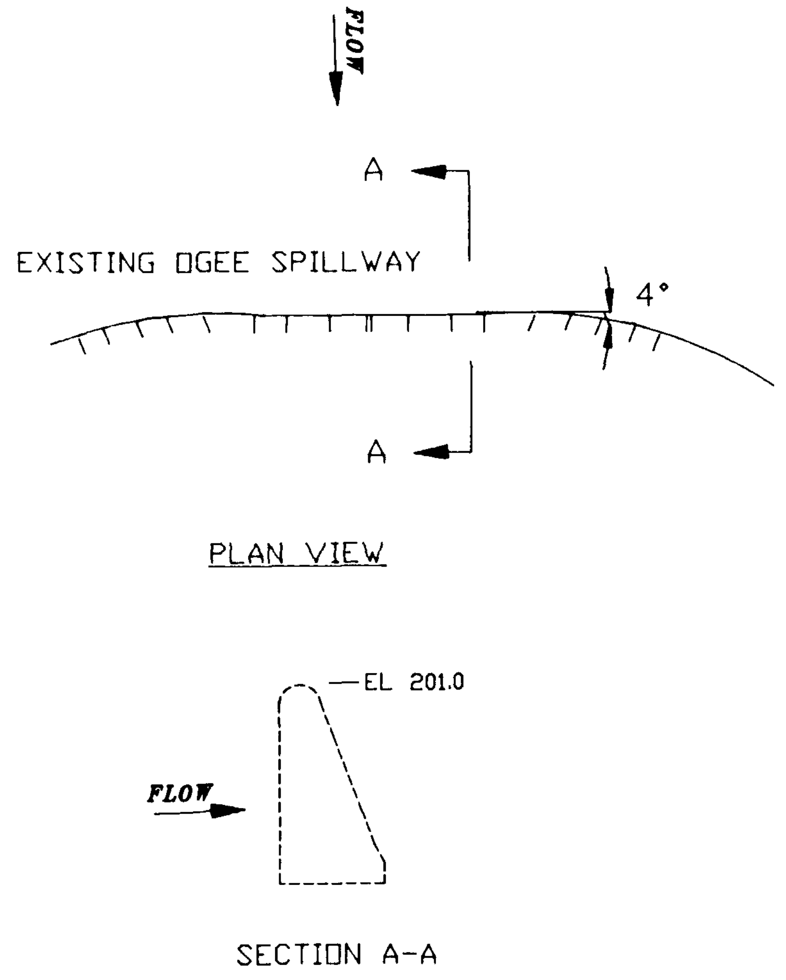
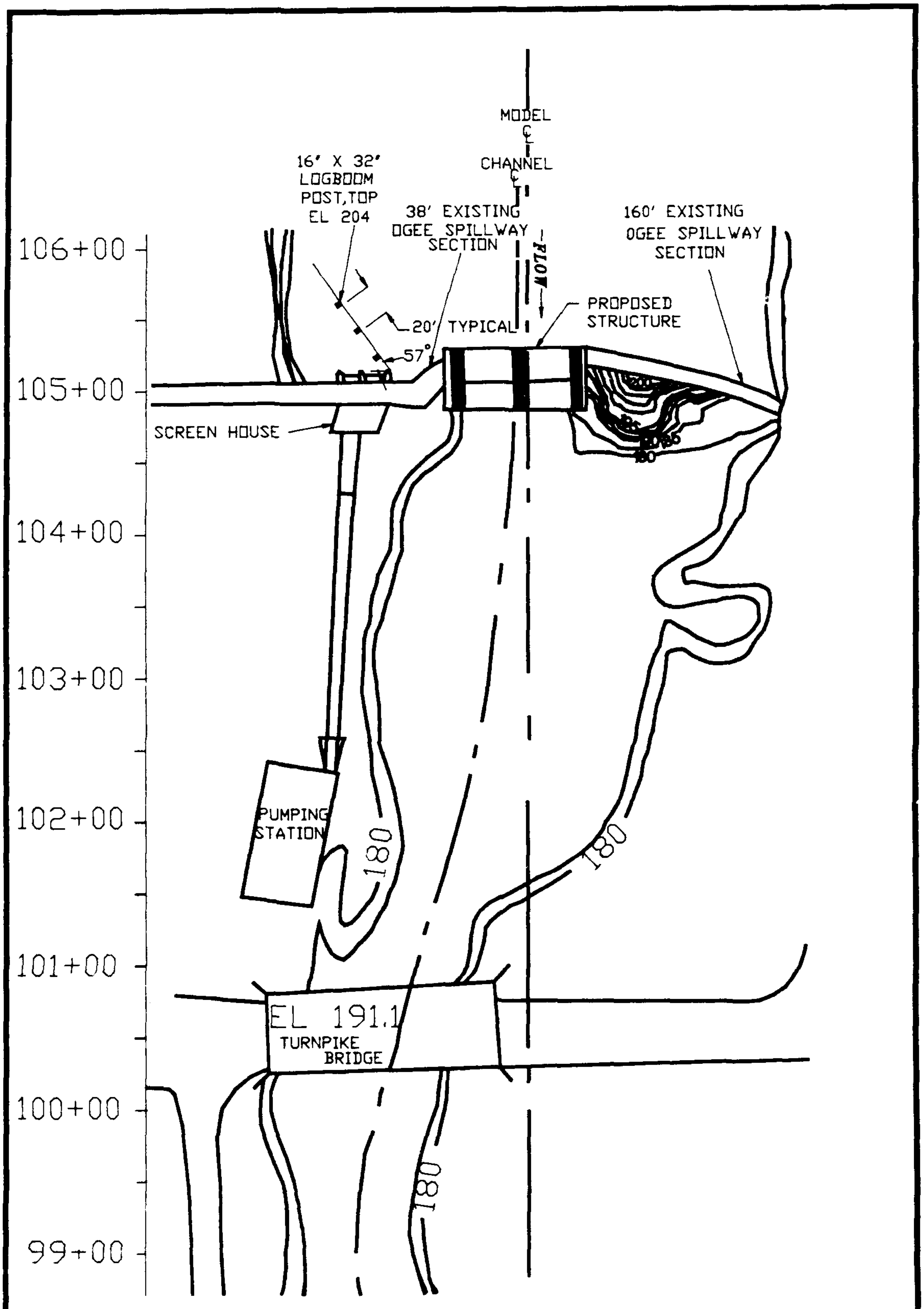


Photo 7. Type 5 design, downstream scour, Q = 16,000 cfs, pool el 201.1, TW el 192.5, T = 10 hr

Photo 8. Type 5 design, downstream scour, Q = 38,500 cfs, pool el 206.5, TW el 199.0, T = 10 hr

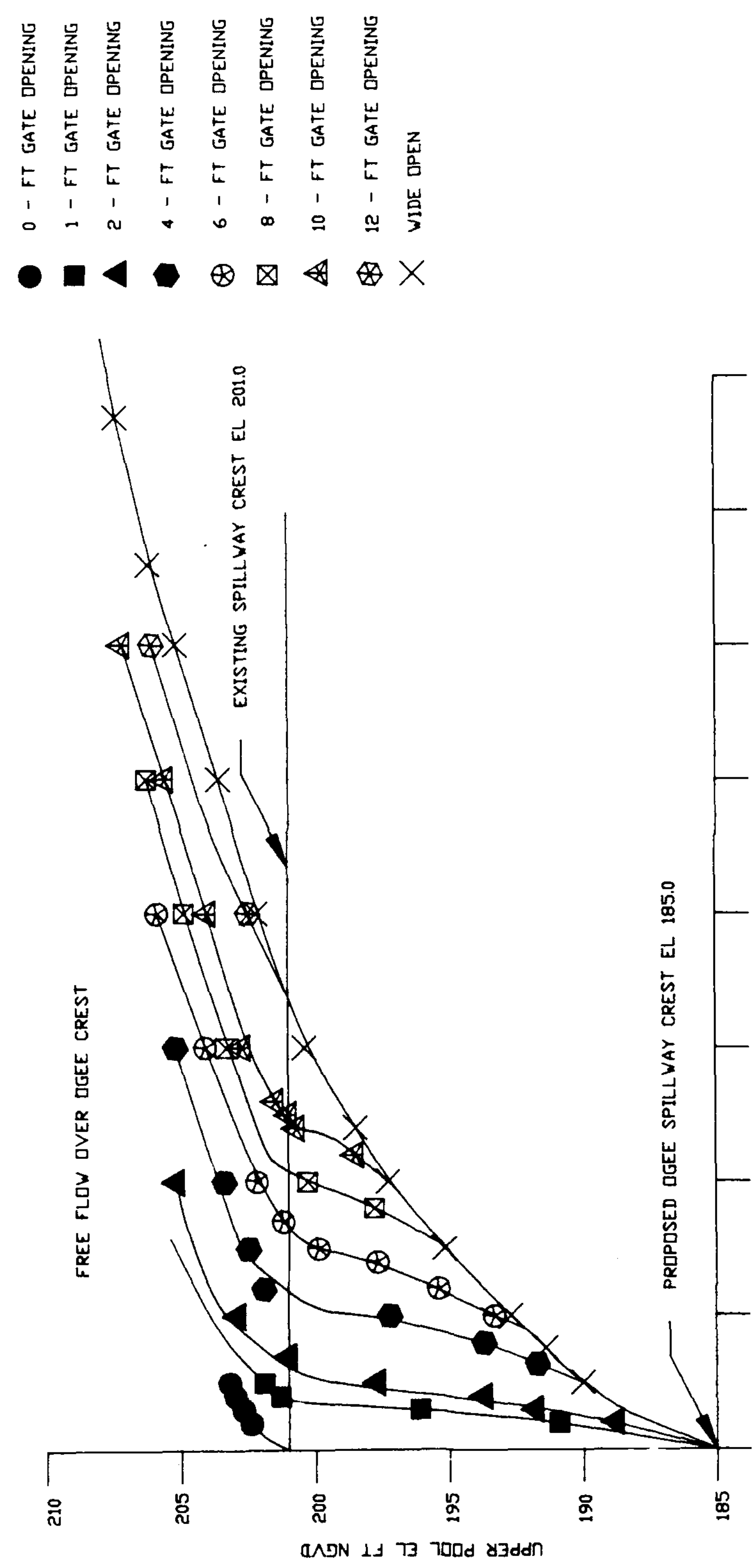


POMPTON DAM
EXISTING SPILLWAY

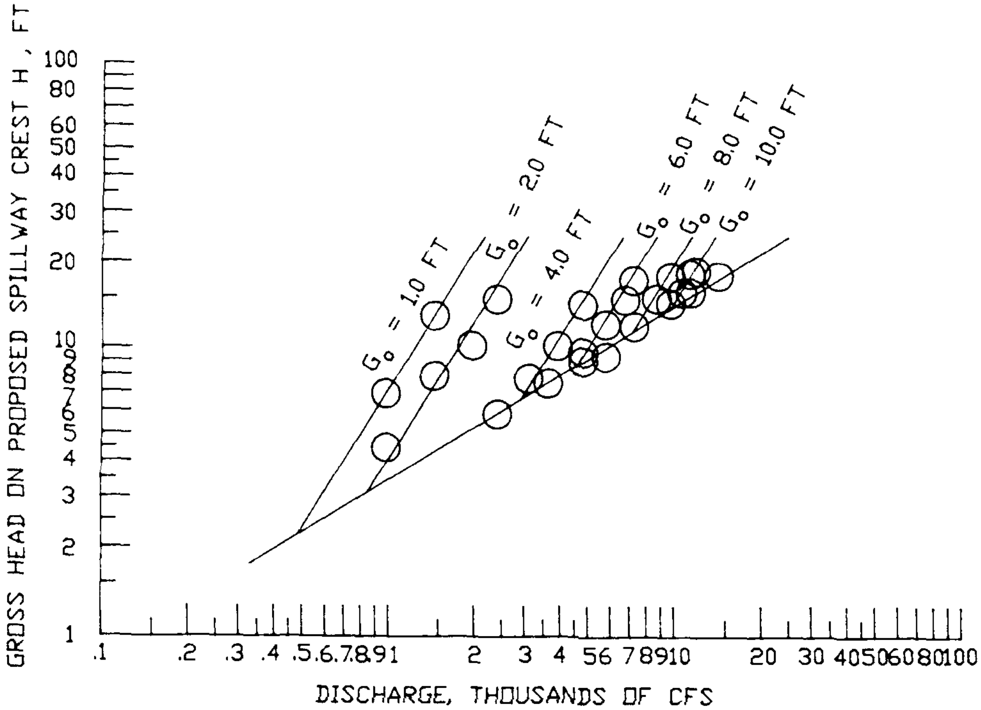


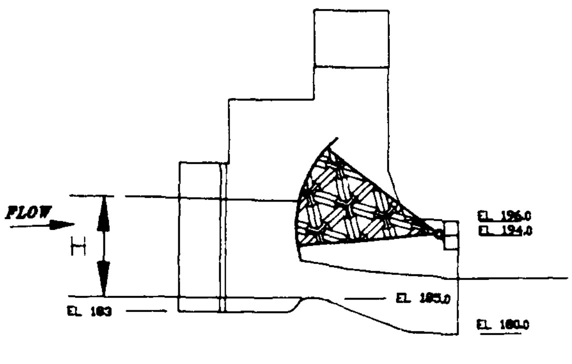
MODEL LAYOUT

PLATE 2



GATE CALIBRATION CURVES
TYPE 1 (ORIGINAL) DESIGN
BOTH GATES OPERATING



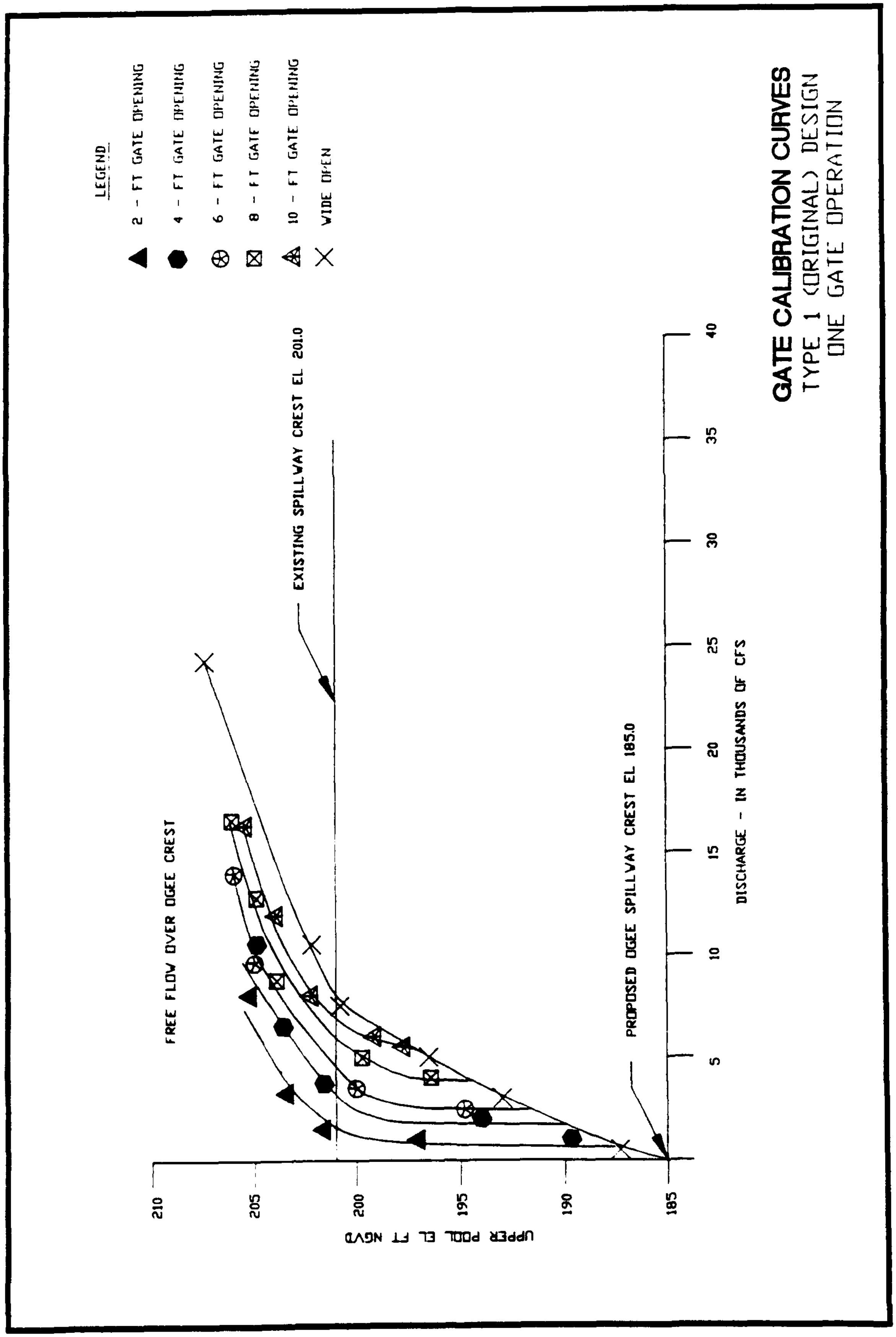


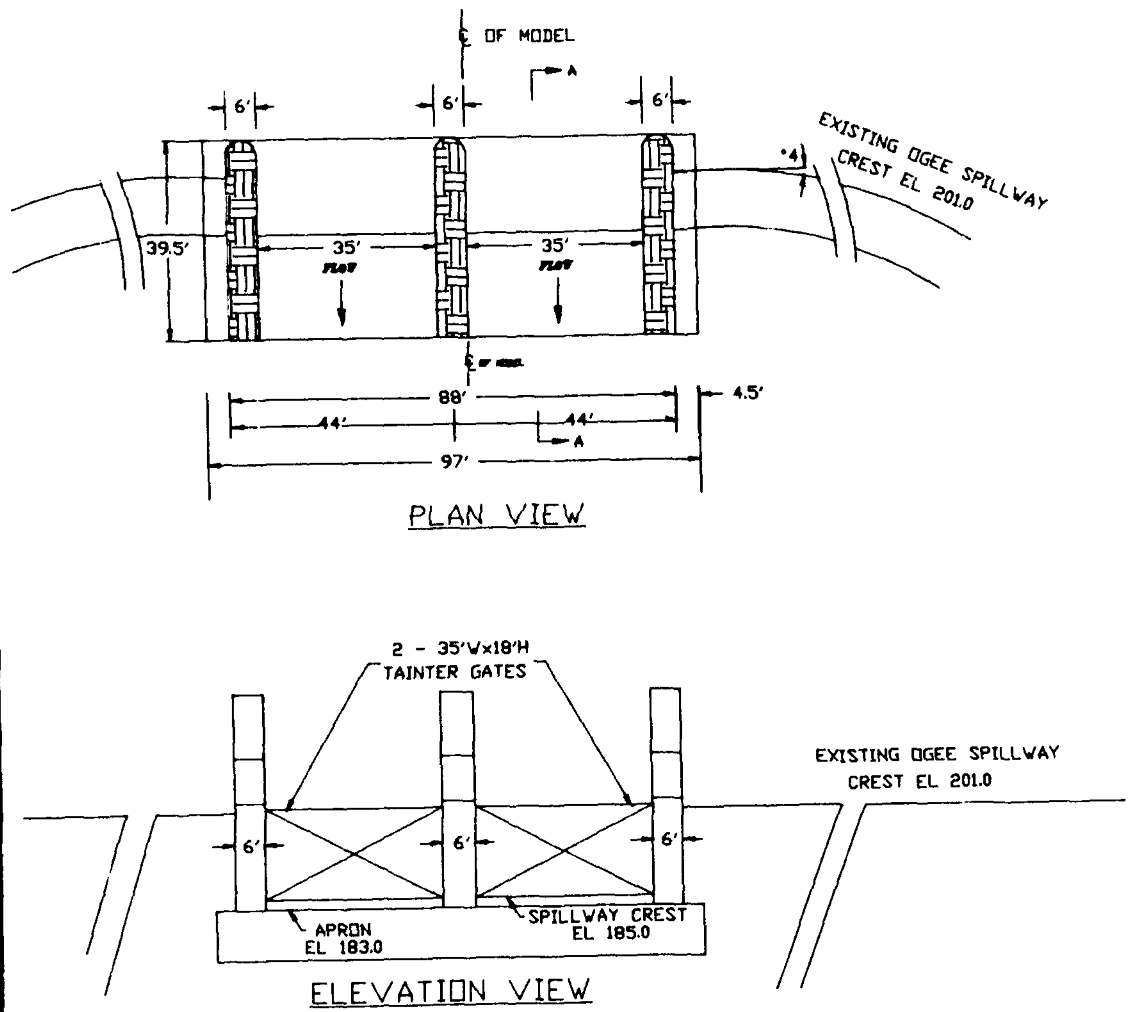
SKETCH

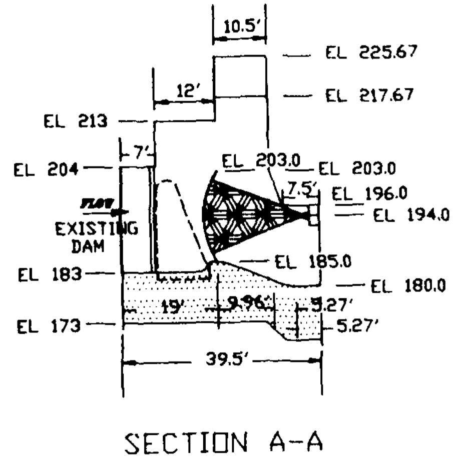
DISCHARGE-HEAD RELATIONSHIP FOR FREE FLOW

FLOW THROUGH

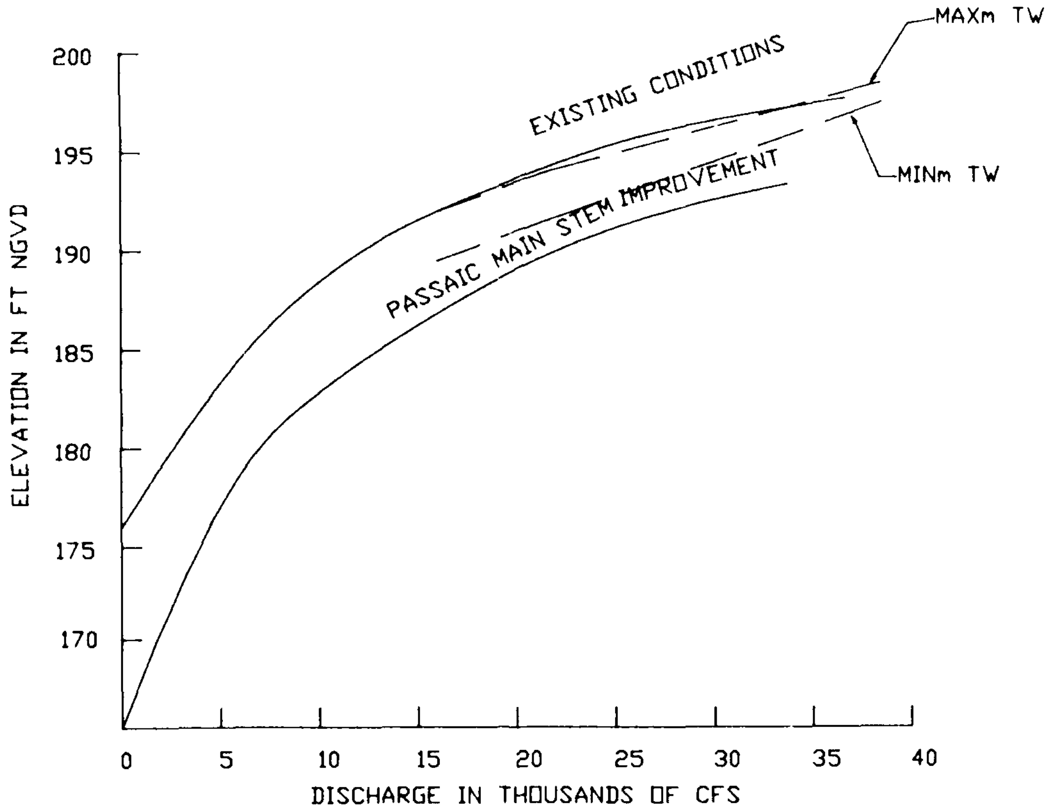
TWO 35-FT-WIDE GATES


GATE CALIBRATION CURVES
TYPE 1 (ORIGINAL) DESIGN
ONE GATE OPERATION
LEGEND
2 - FT GATE OPENING
4 - FT GATE OPENING
6 - FT GATE OPENING
8 - FT GATE OPENING
10 - FT GATE OPENING
WIDE OPEN
FREE FLOW OVER OGEE CREST
EXISTING SPILLWAY CREST EL 201.0
PROPOSED OGEE SPILLWAY CREST EL 185.0
UPPER POOL EL FT NGVD
DISCHARGE - IN THOUSANDS OF CFS
210
205
200
195
190
185
5
10
15
20
25
30
35
40





TYPE 1 (ORIGINAL) DESIGN SPILLWAY



TAILWATER RATING CURVES
STA 102+25

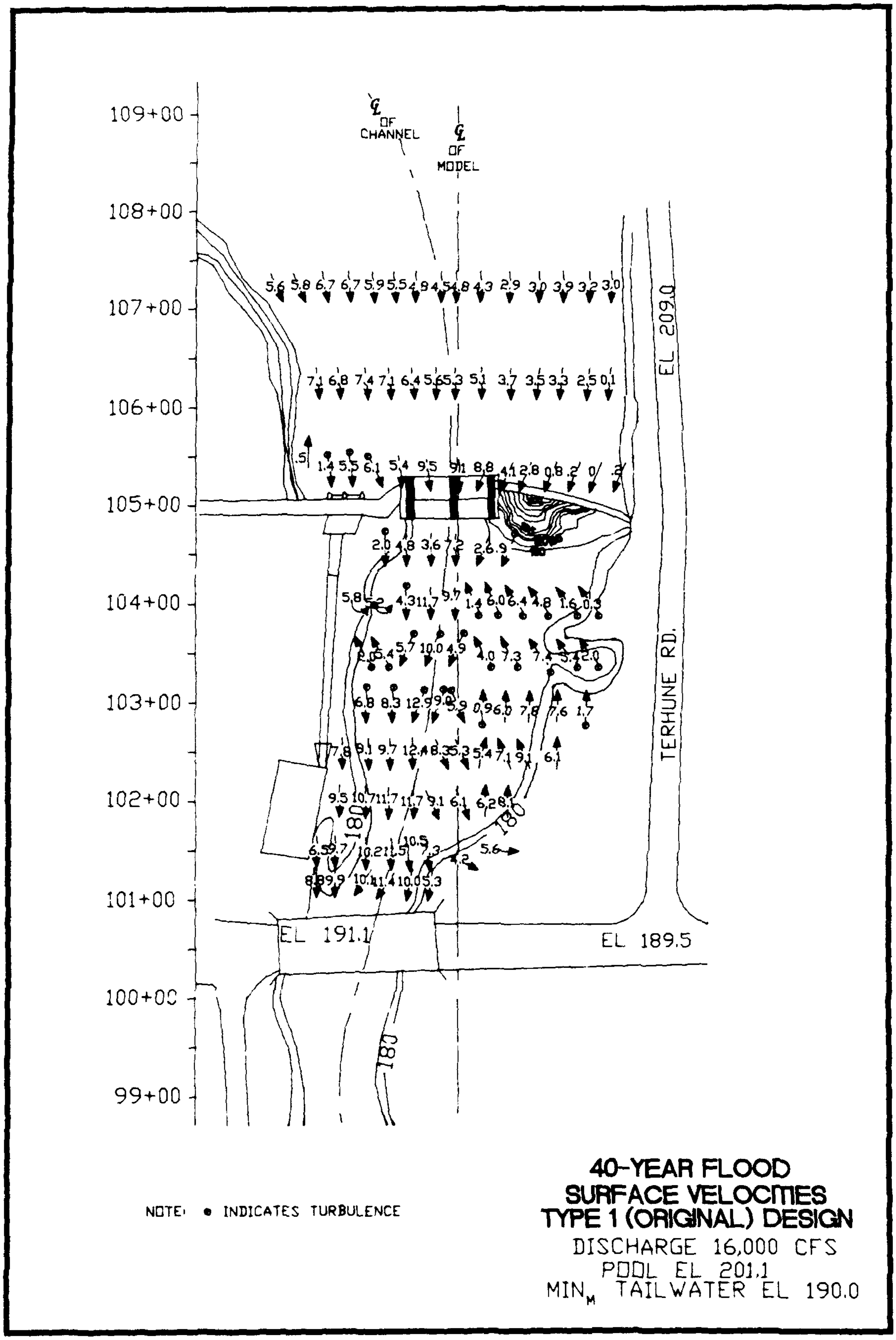


PLATE 8
(Sheet 1 of 3)

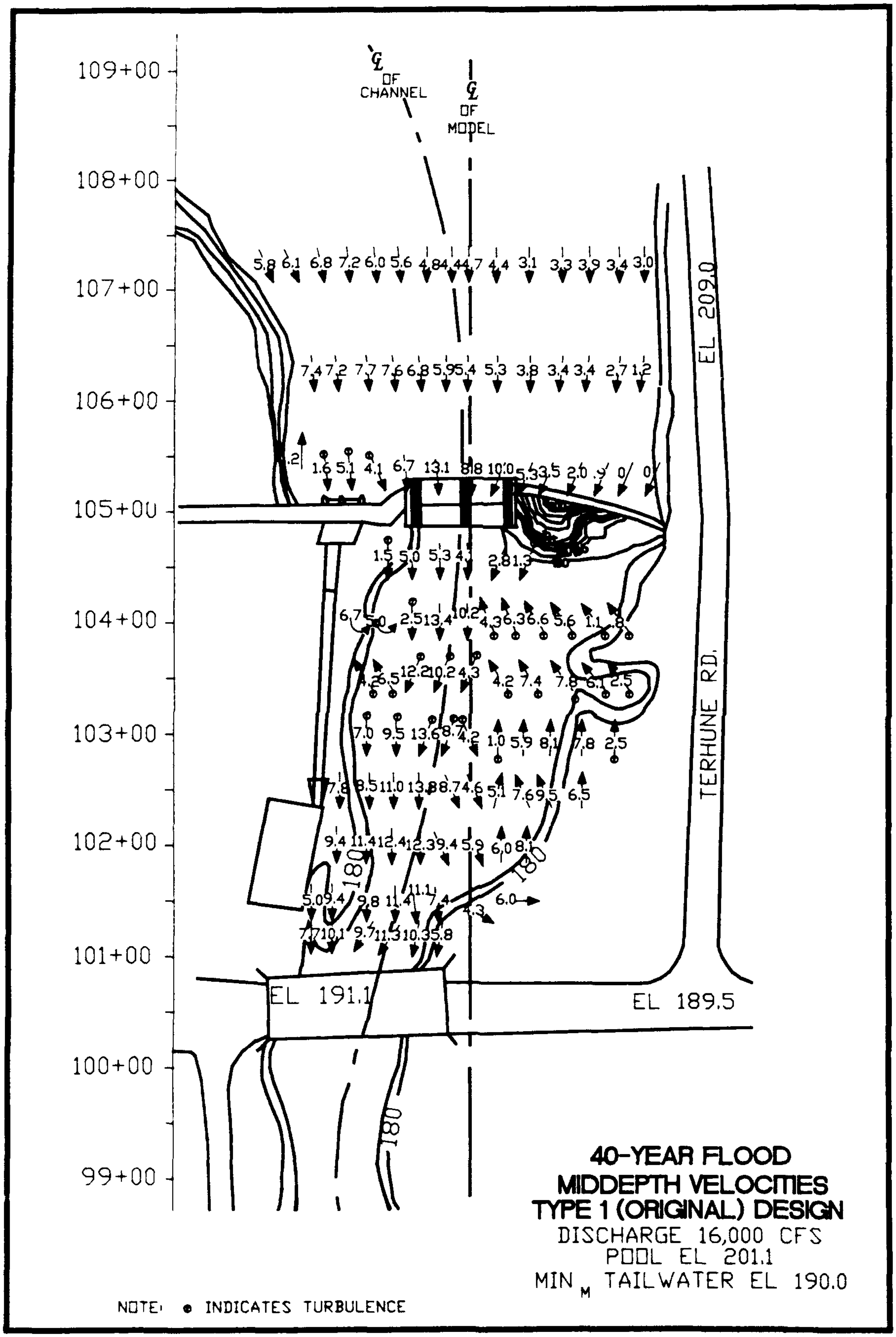


PLATE 8
(Sheet 2 of 3)

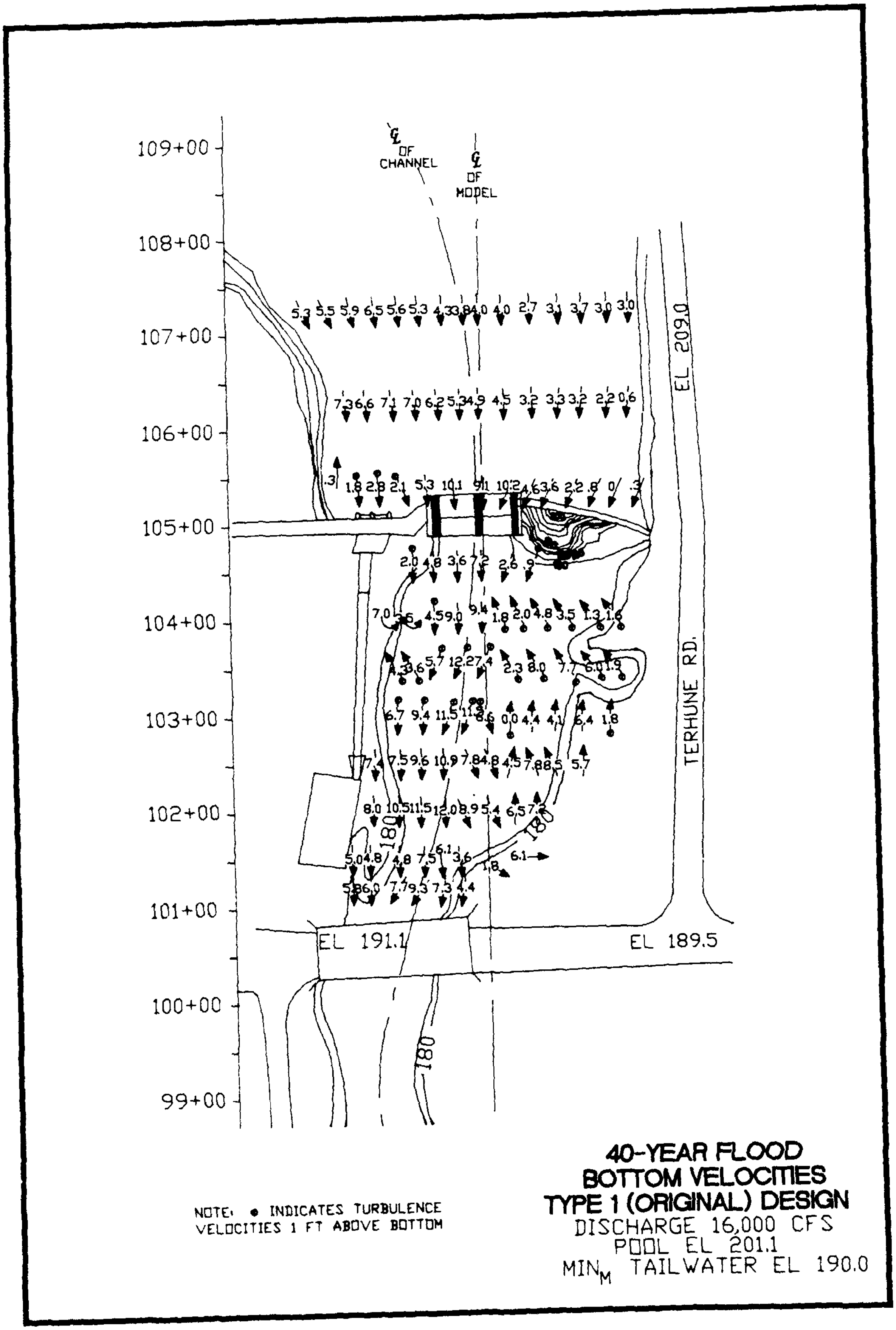
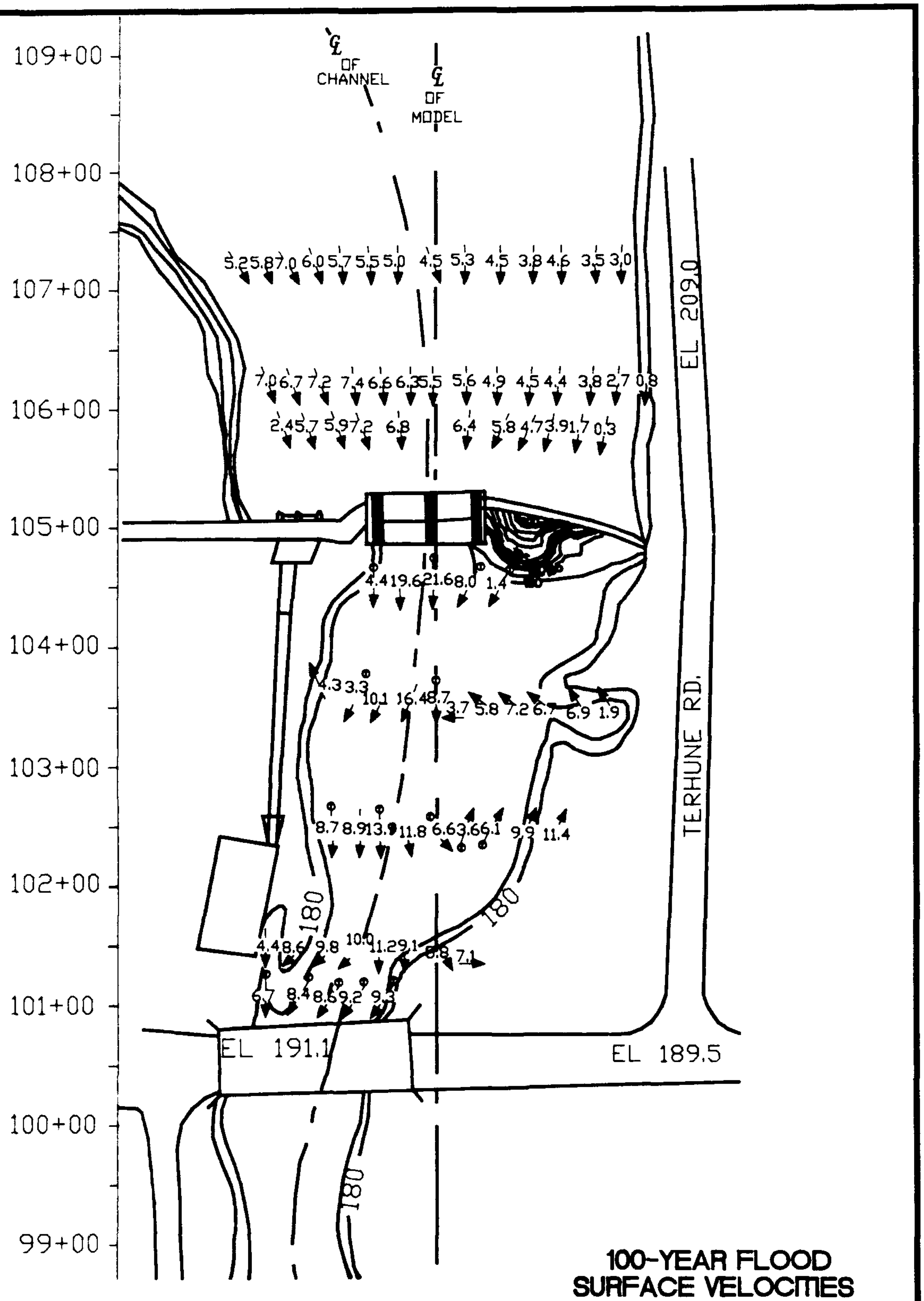


PLATE 8
(Sheet 3 of 3)



100-YEAR FLOOD
SURFACE VELOCITIES
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 21,500 CFS
POOL EL 202.9
MIN M TAILWATER EL 192.0

NOTE: ⊗ INDICATES TURBULENCE

PLATE 9
(Sheet 1 of 3)

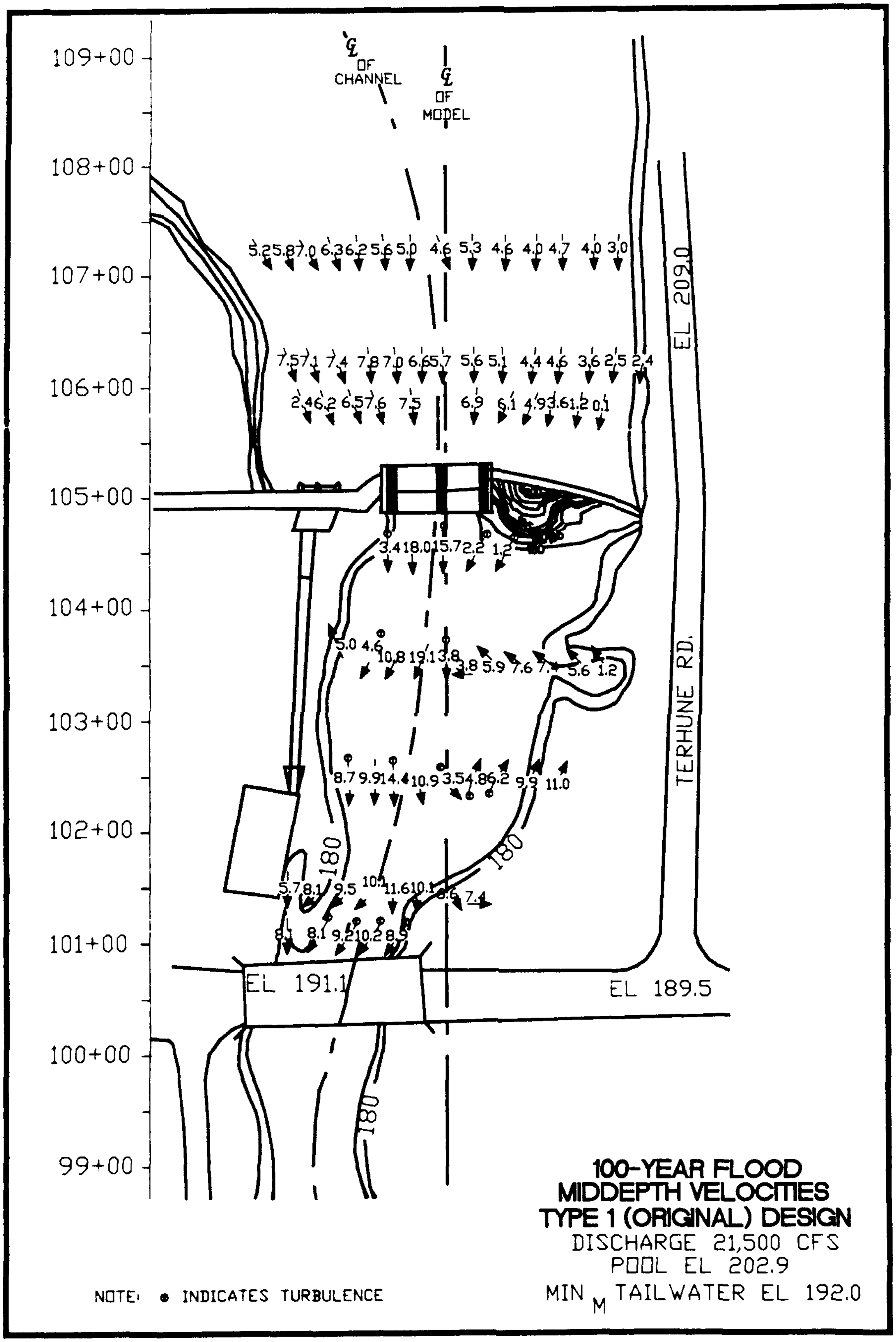


PLATE 9
(Sheet 2 of 3)

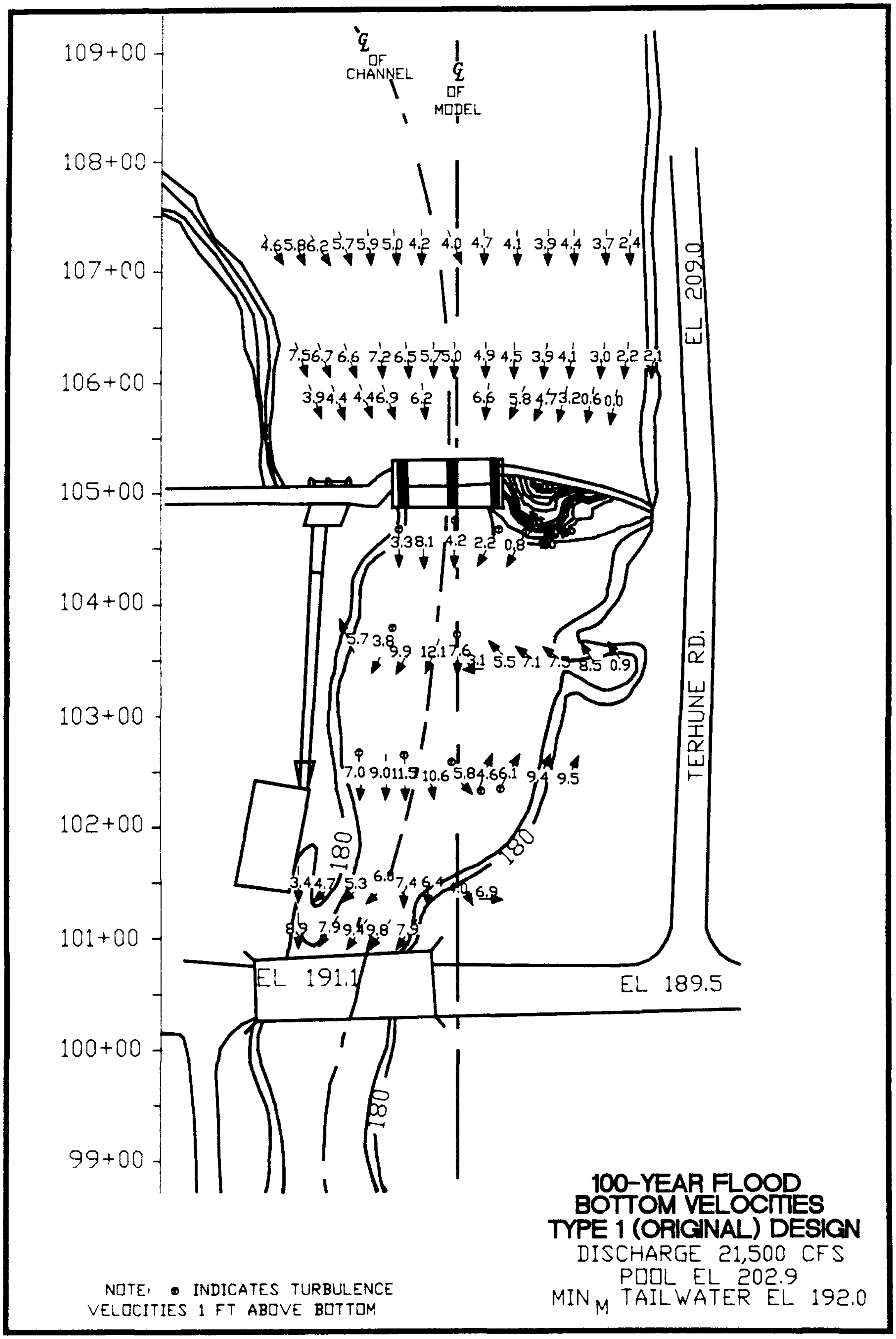
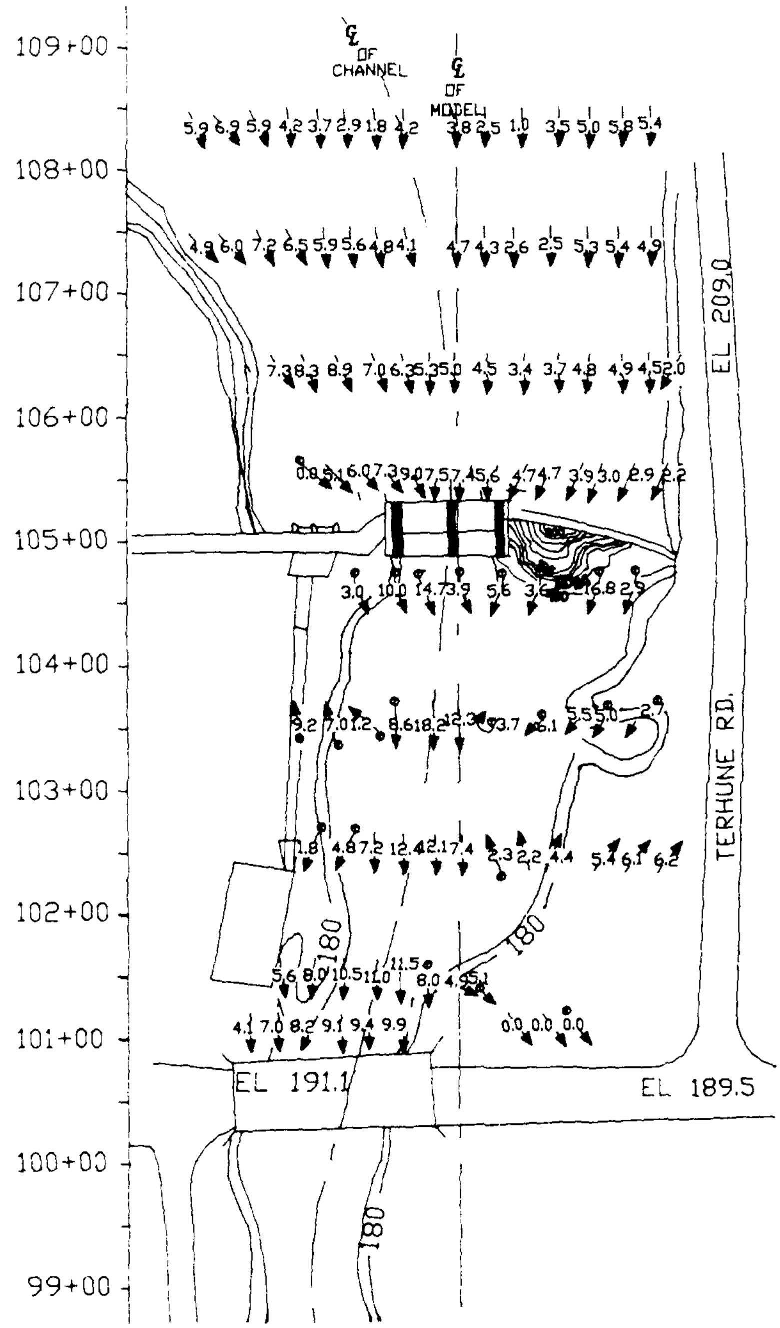


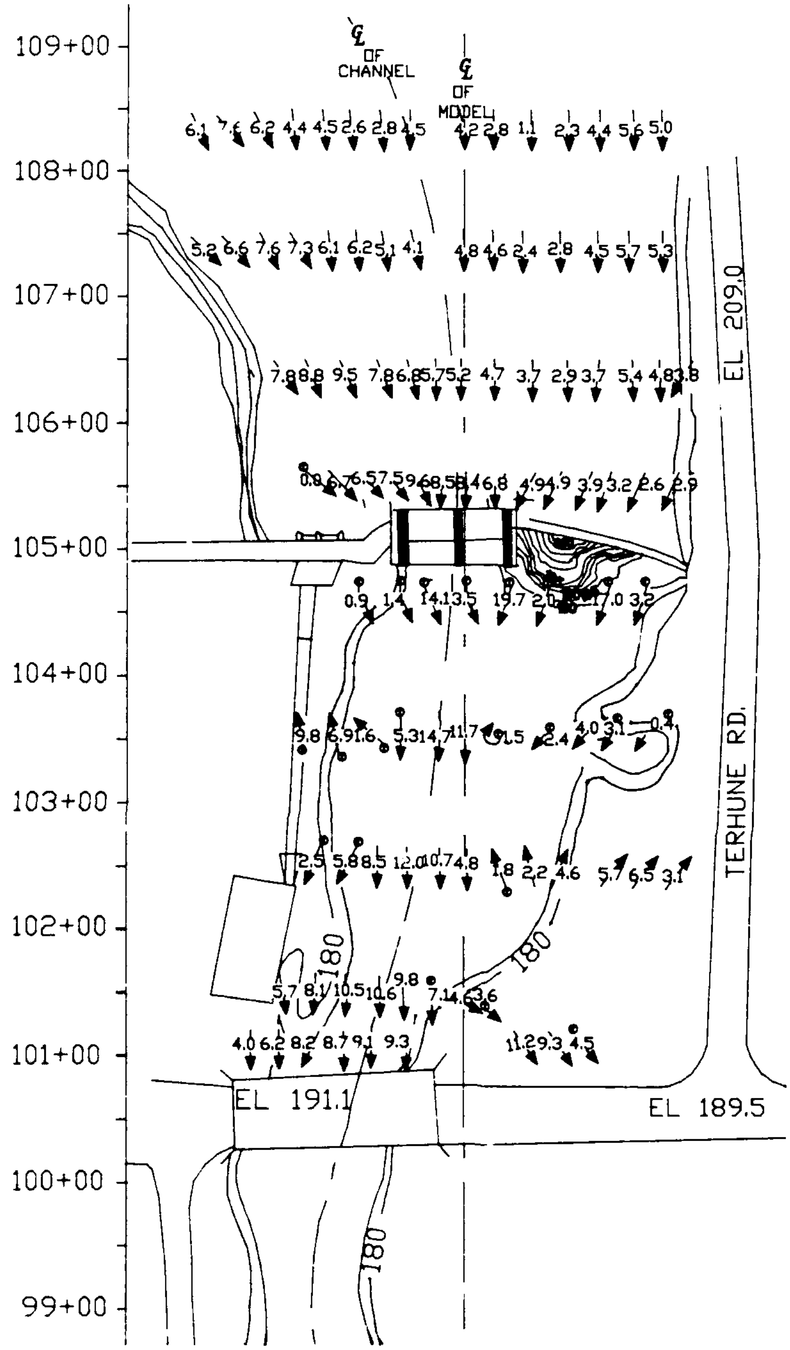
PLATE 9
(Sheet 3 of 3)



NOTE: • INDICATES TURBULENCE

SPF
SURFACE VELOCITIES
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 38,500 CFS
POOL EL 206.5
MIN TAILWATER EL 198.0

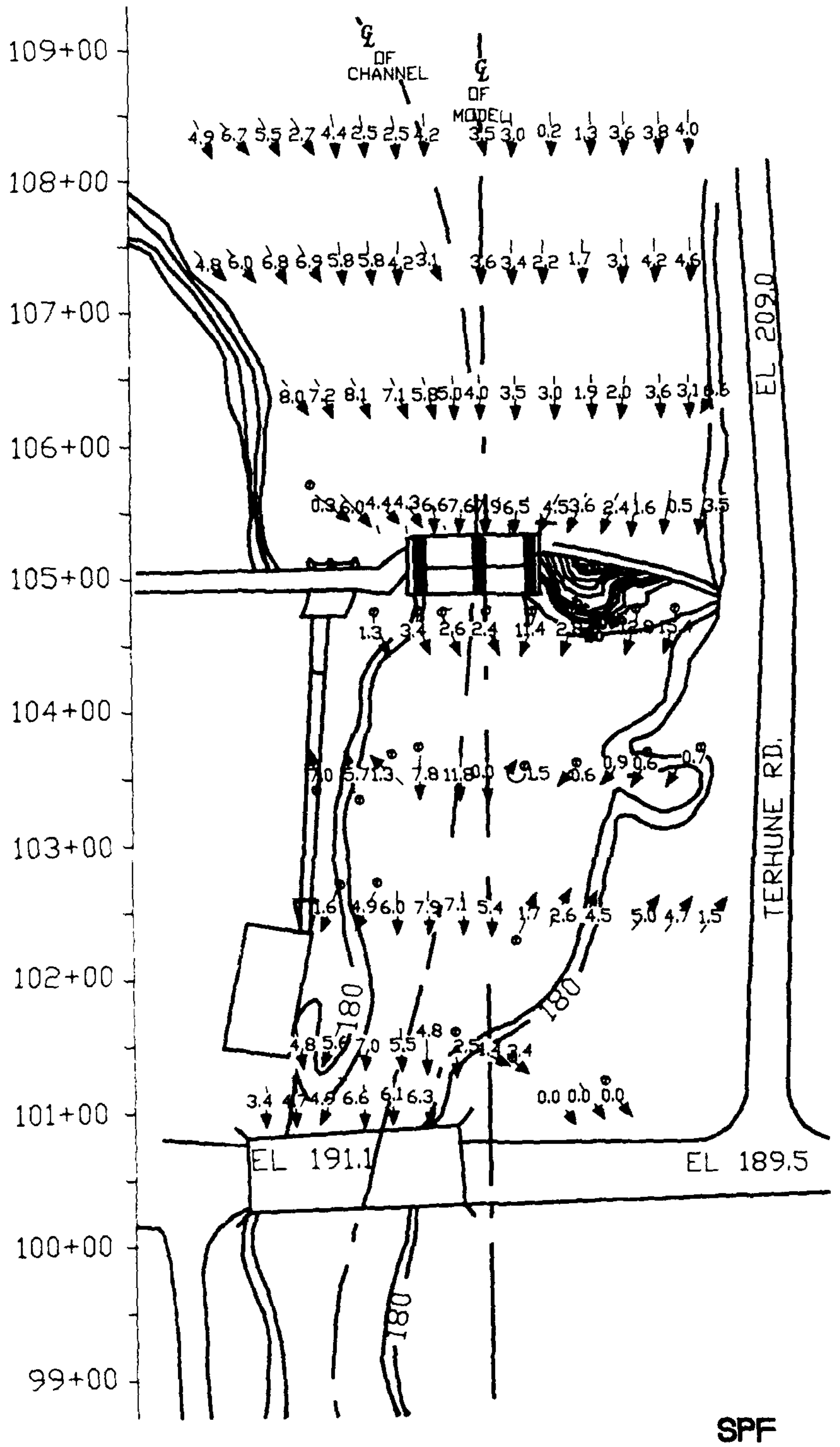
PLATE 10
(Sheet 1 of 3)



NOTE: ● INDICATES TURBULENCE

SPF
MIDDEPTH VELOCITIES
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 38,500 CFS
POOL EL 206.5
MIN TAILWATER EL 198.0

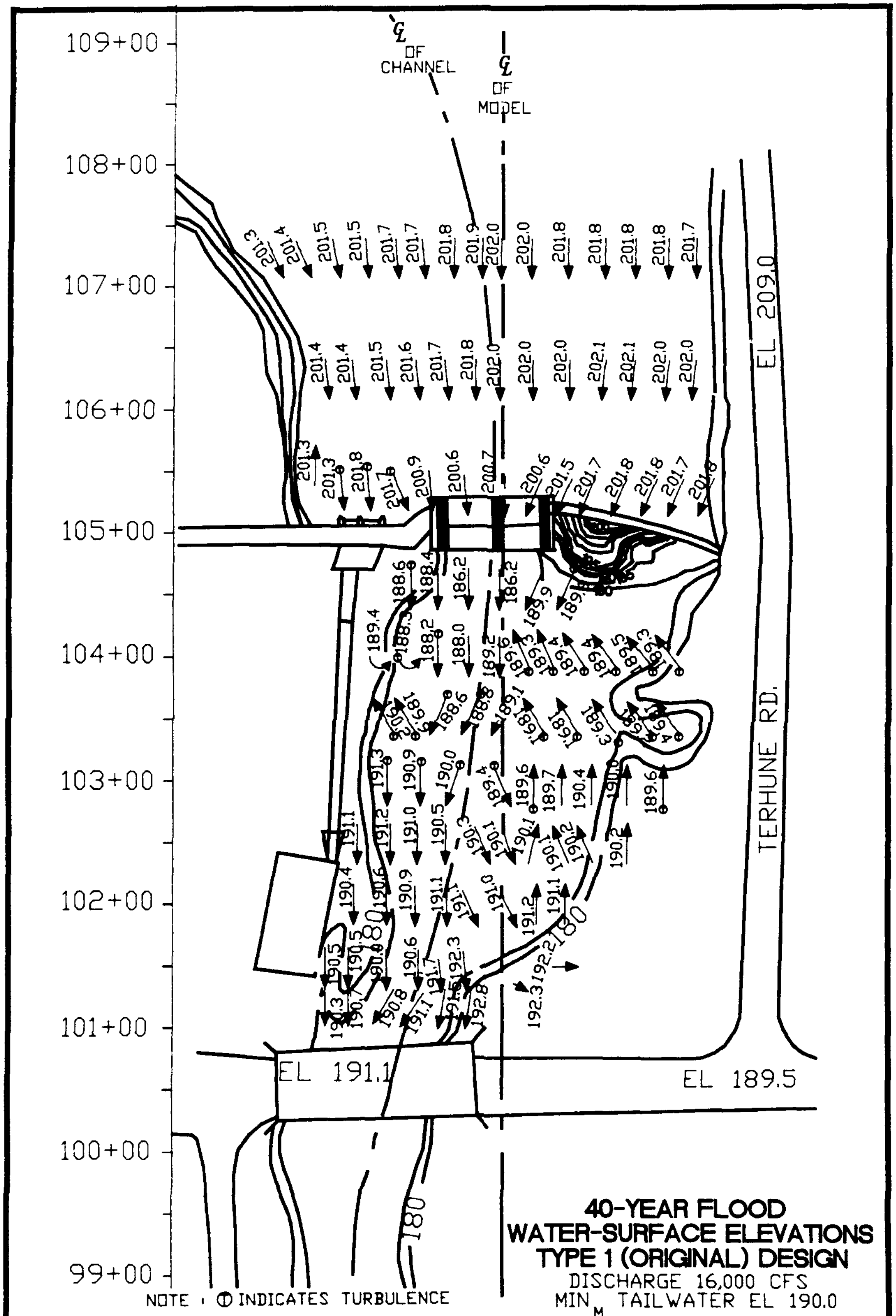
PLATE 10
(Sheet 2 of 3)



SPF
BOTTOM VELOCITIES
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 38,500 CFS
POOL EL 206.5
MIN$_M$ TAILWATER EL 198.0

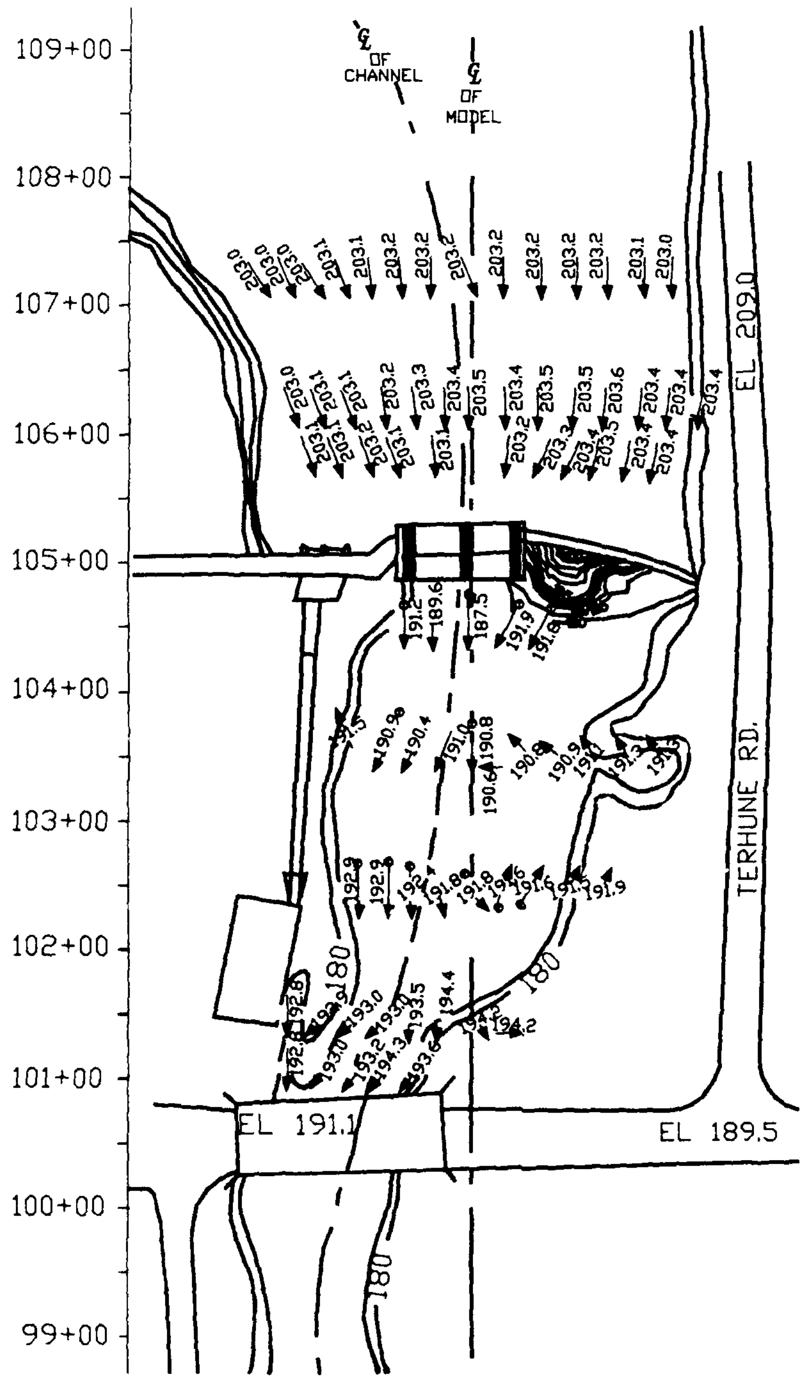
NOTE: ⊗ INDICATES TURBULENCE
VELOCITIES 1 FT ABOVE BOTTOM

PLATE 10
(Sheet 3 of 3)



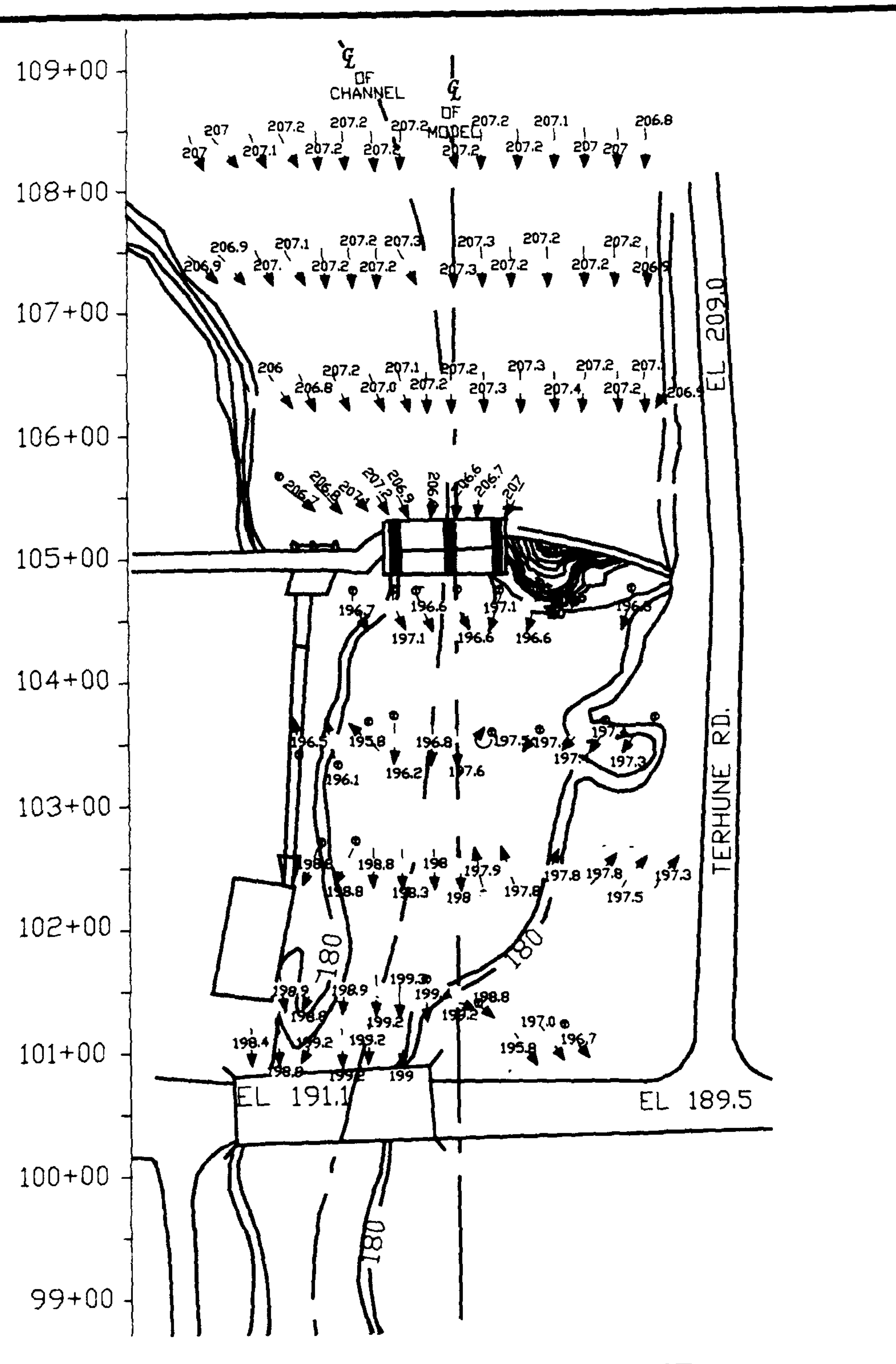
40-YEAR FLOOD
WATER-SURFACE ELEVATIONS
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 16,000 CFS
MIN TAILWATER EL 190.0

NOTE: ① INDICATES TURBULENCE



100-YEAR FLOOD
WATER-SURFACE ELEVATIONS
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 21,500 CFS
MIN$_M$ TAILWATER EL 192.0

NOTE: • INDICATES TURBULENCE



NOTE: ⊙ INDICATES TURBULENCE

SPF
WATER-SURFACE ELEVATIONS
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 38,500 CFS
MIN TAILWATER EL 198.0

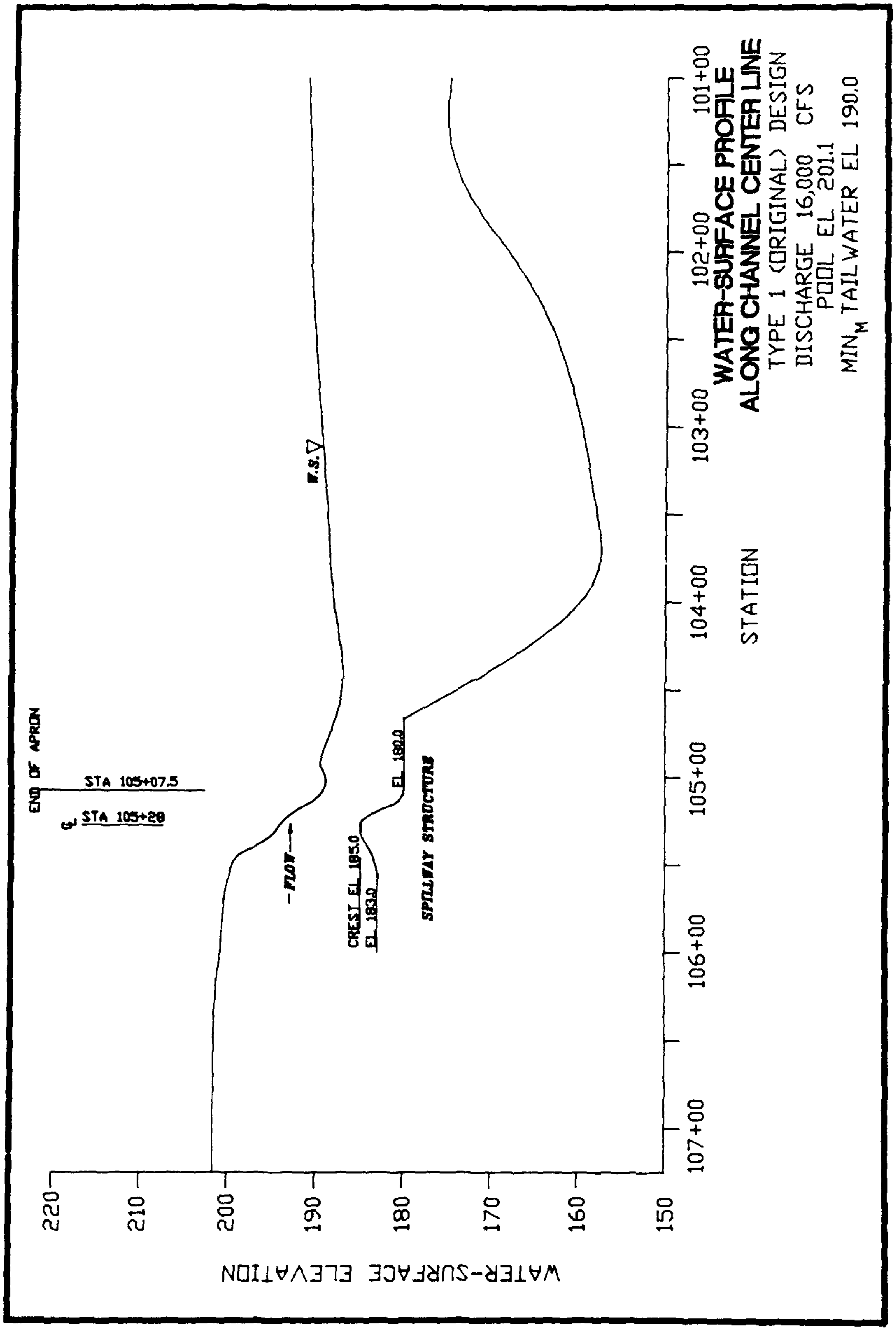
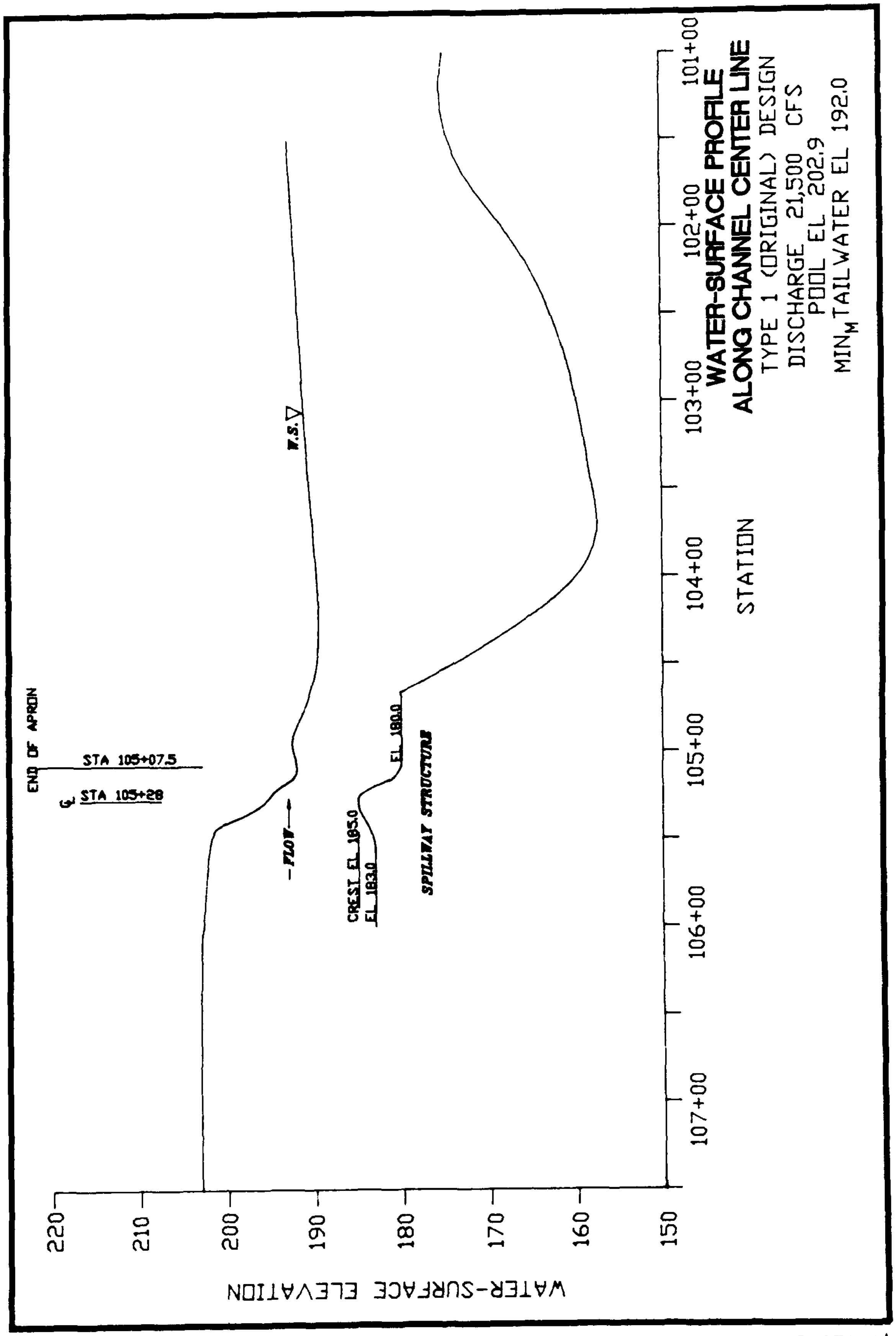


PLATE 14
(Sheet 1 of 3)


WATER-SURFACE PROFILE
ALONG CHANNEL CENTER LINE
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 21,500 CFS
POOL EL 202.9
MIN$_M$ TAILWATER EL 192.0
WATER-SURFACE ELEVATION
STATION
220
210
200
190
180
170
160
150
101+00
102+00
103+00
104+00
105+00
106+00
107+00
W.S.
END OF APRON
STA 105+07.5
℄ STA 105+28
FLOW
CREST EL 185.0
EL 183.0
EL 180.0
SPILLWAY STRUCTURE

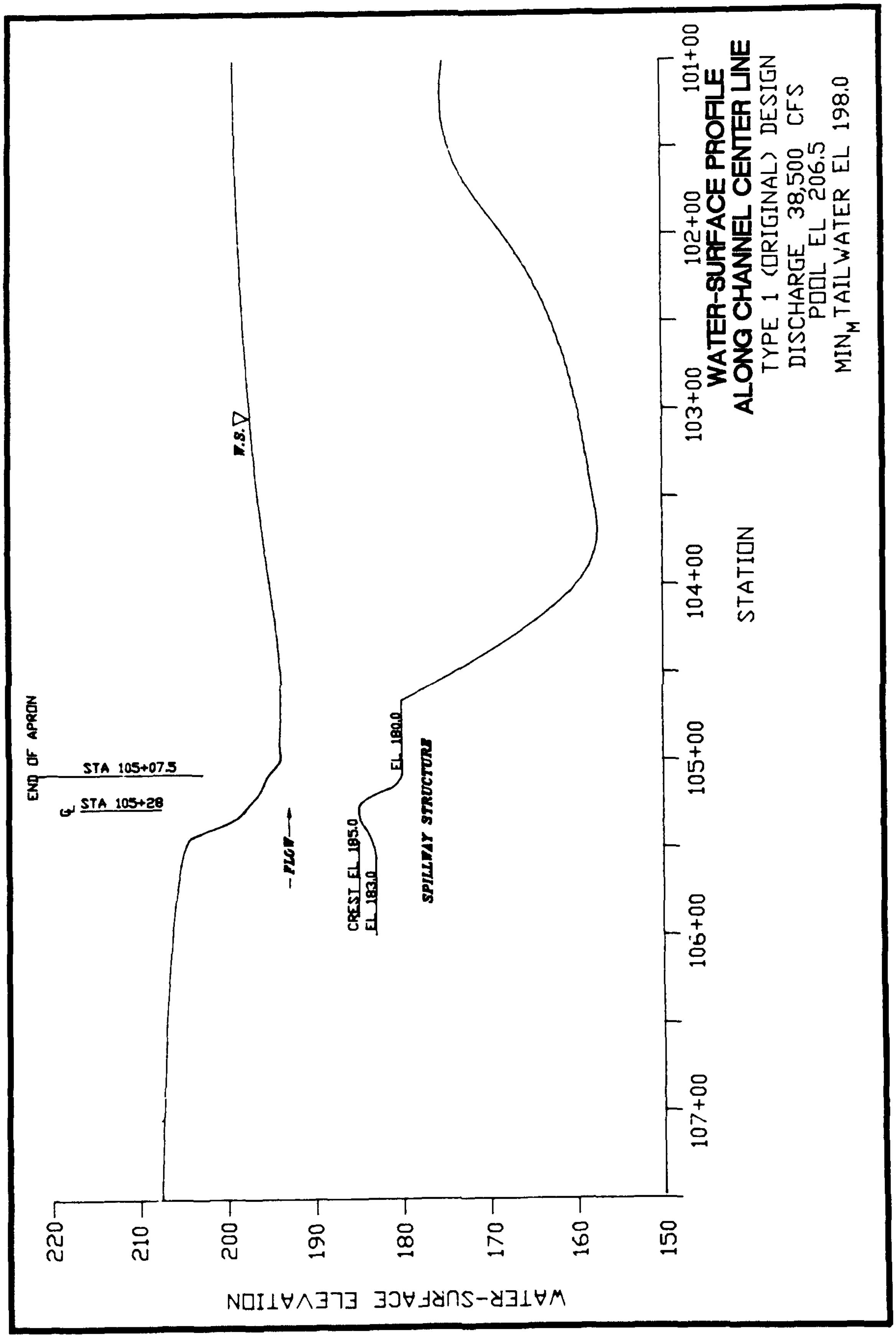
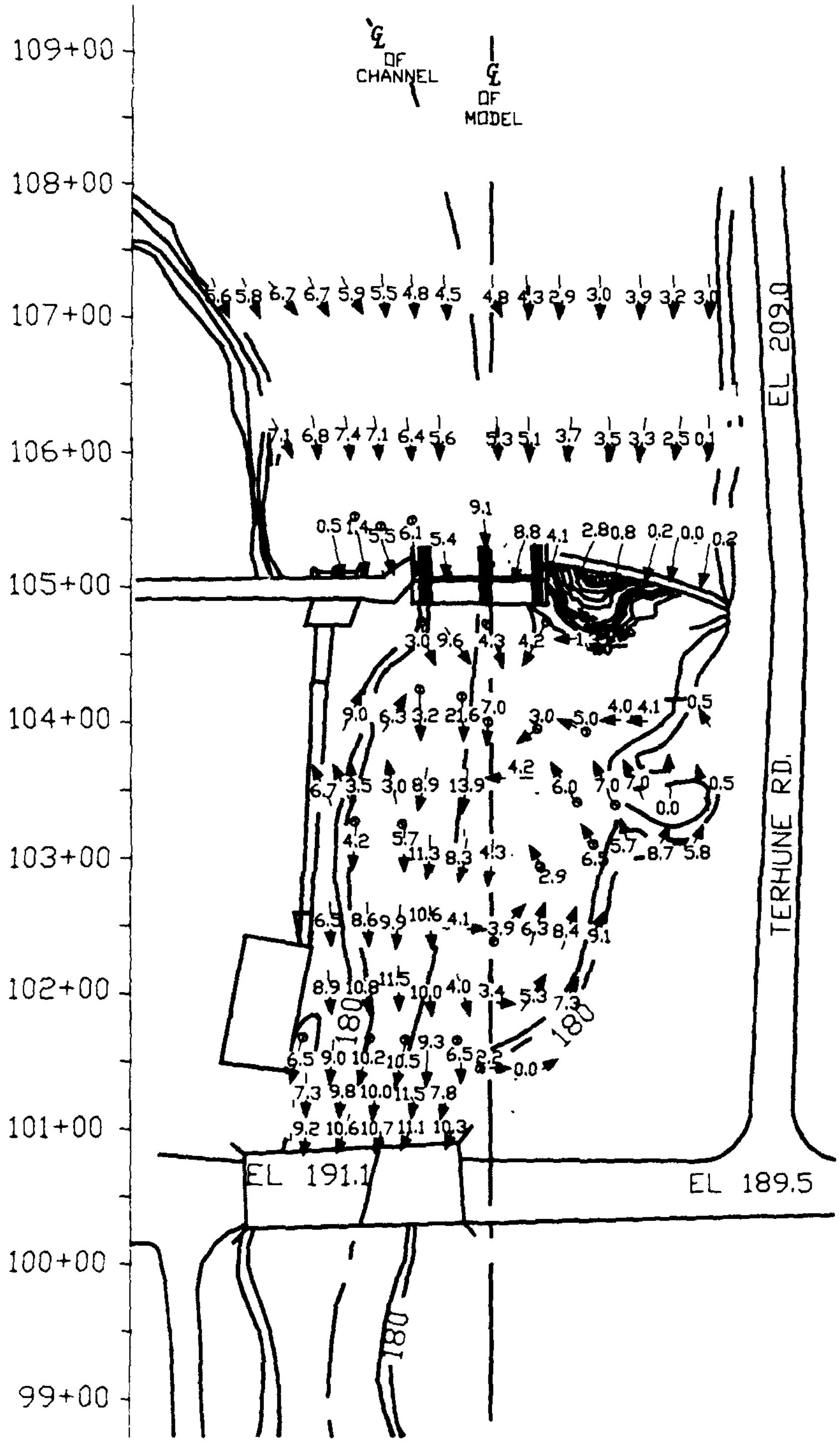
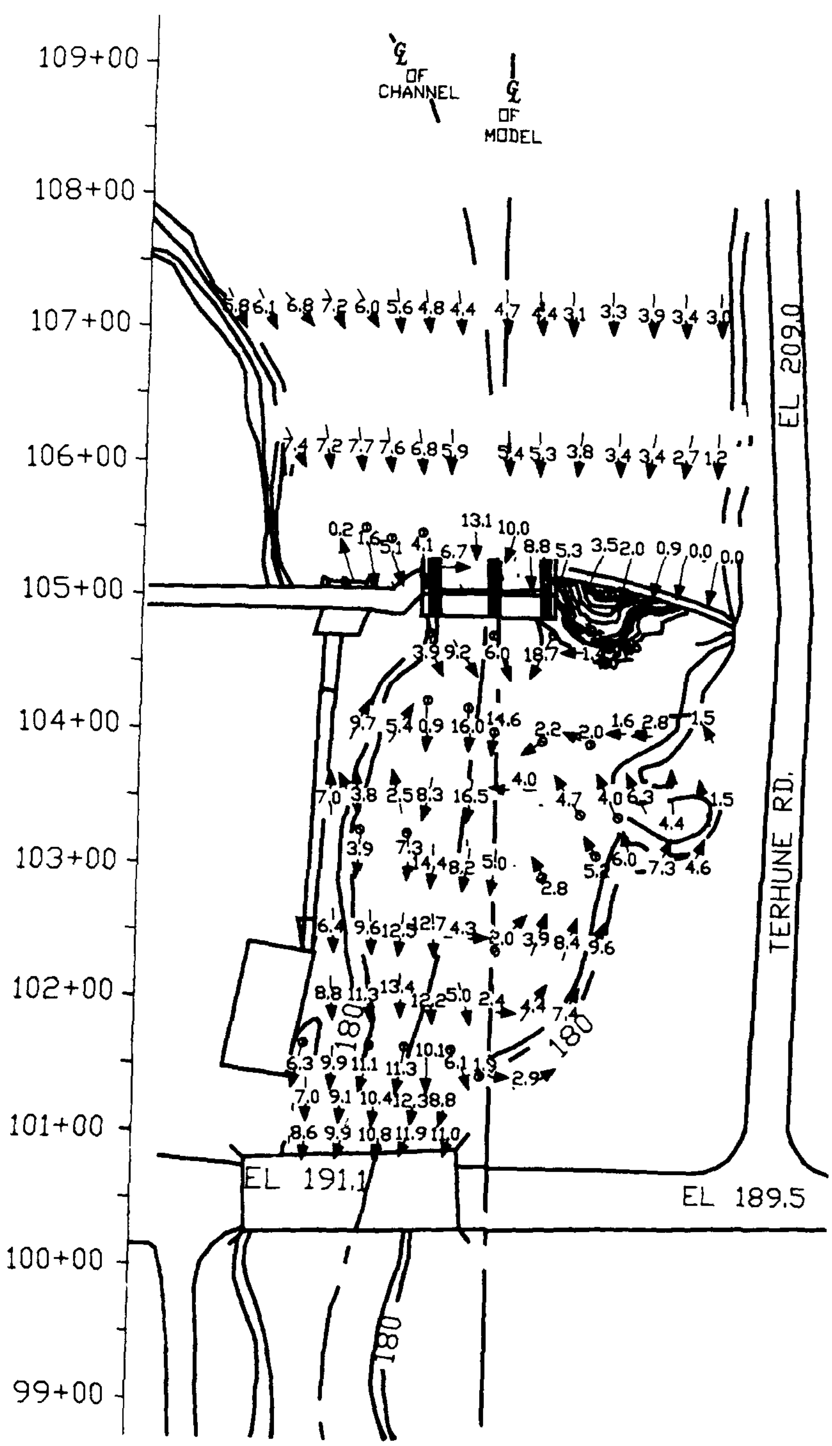


PLATE 14
(Sheet 3 of 3)



40-YEAR FLOOD
SURFACE VELOCITIES
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 16,000 CFS
POOL EL 201.1
MAX M TAILWATER EL 192.5

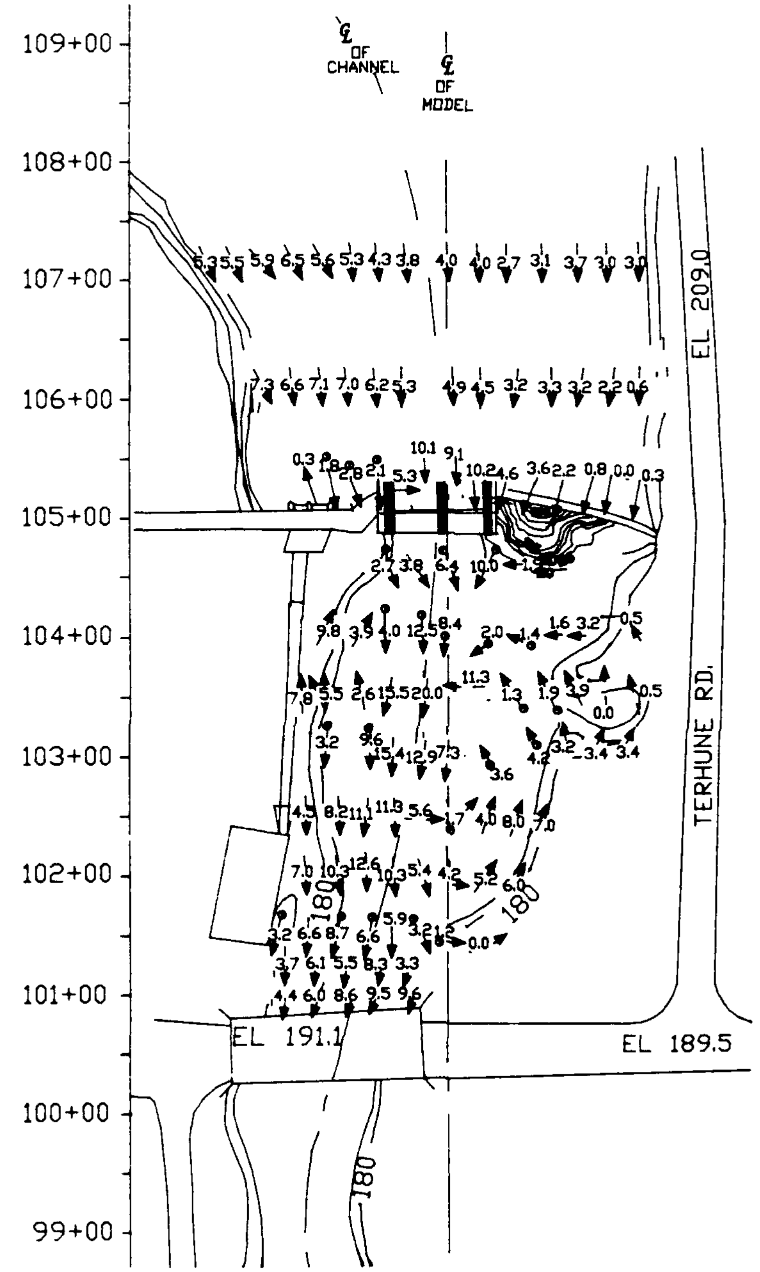
PLATE 15
(Sheet 1 of 3)



NOTE: ● INDICATES TURBULENCE

40-YEAR FLOOD
MIDDEPTH VELOCITIES
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 16,000 CFS
POOL EL 201.1
MAX_M TAILWATER EL 192.5

PLATE 15
(Sheet 2 of 3)



NOTE: • INDICATES TURBULENCE
VELOCITIES 1 FT ABOVE BOTTOM

40-YEAR FLOOD
BOTTOM VELOCITIES
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 16,000 CFS
POOL EL 201.1
MAX$_M$ TAILWATER EL 192.5

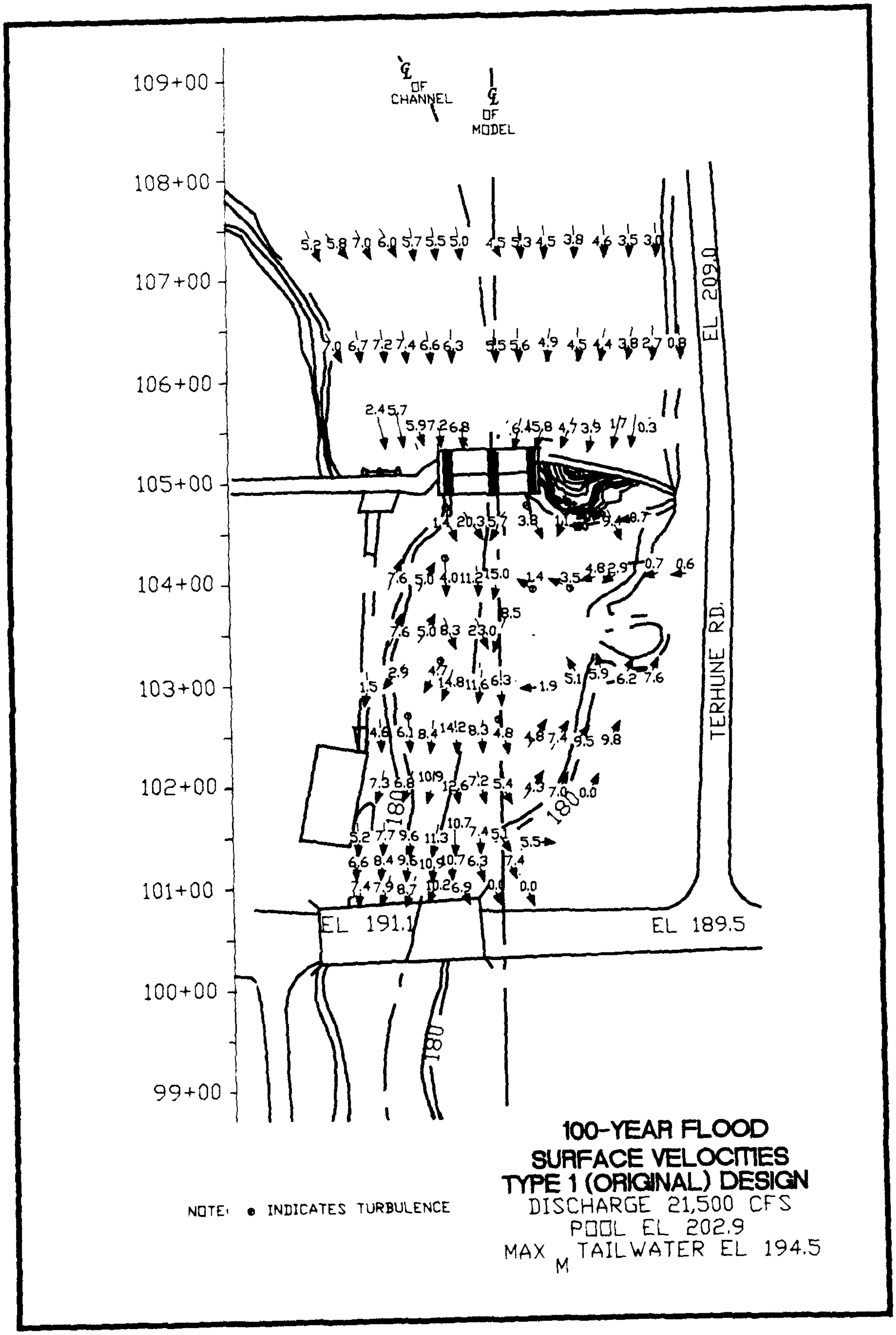


PLATE 16
(Sheet 1 of 3)

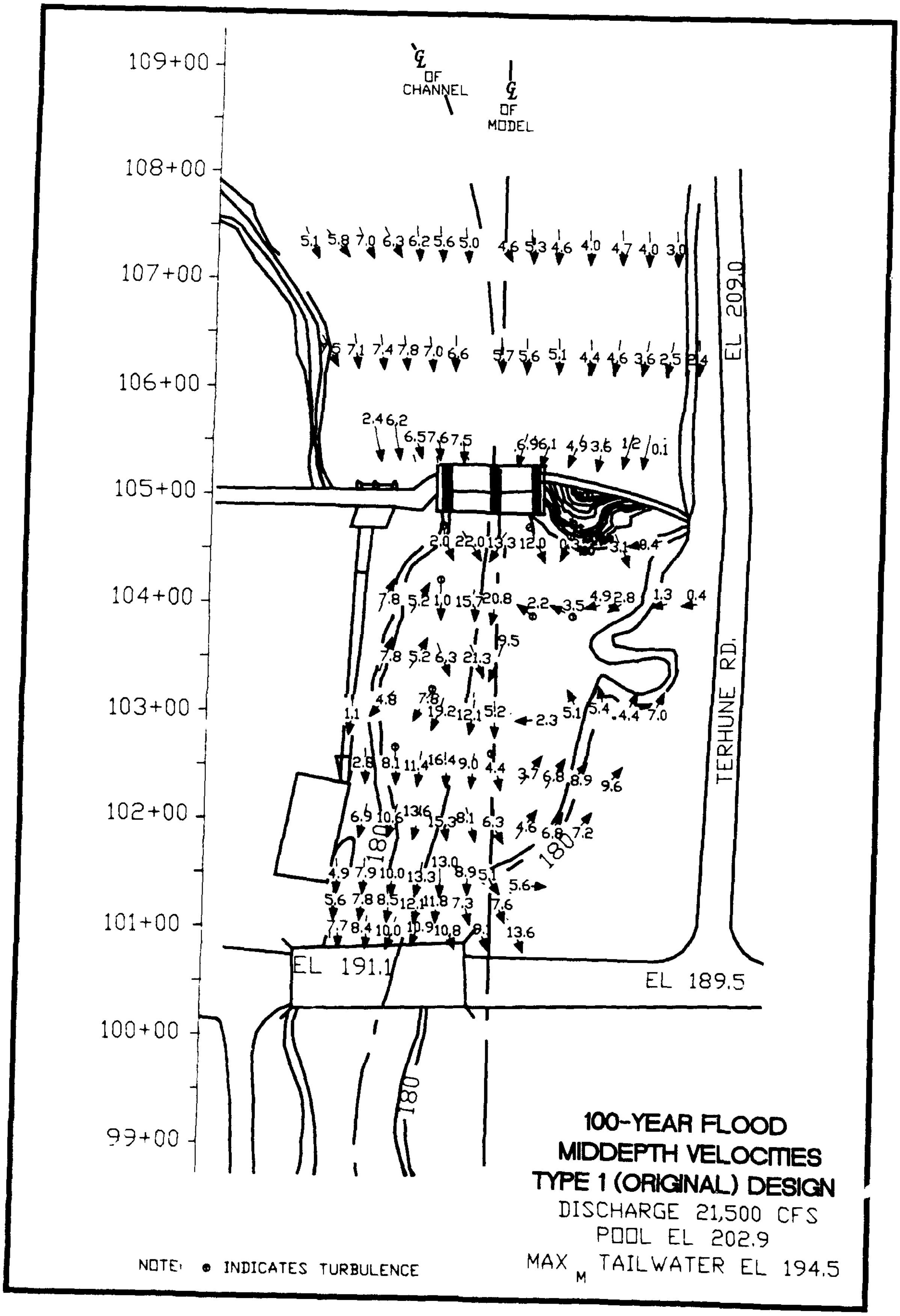
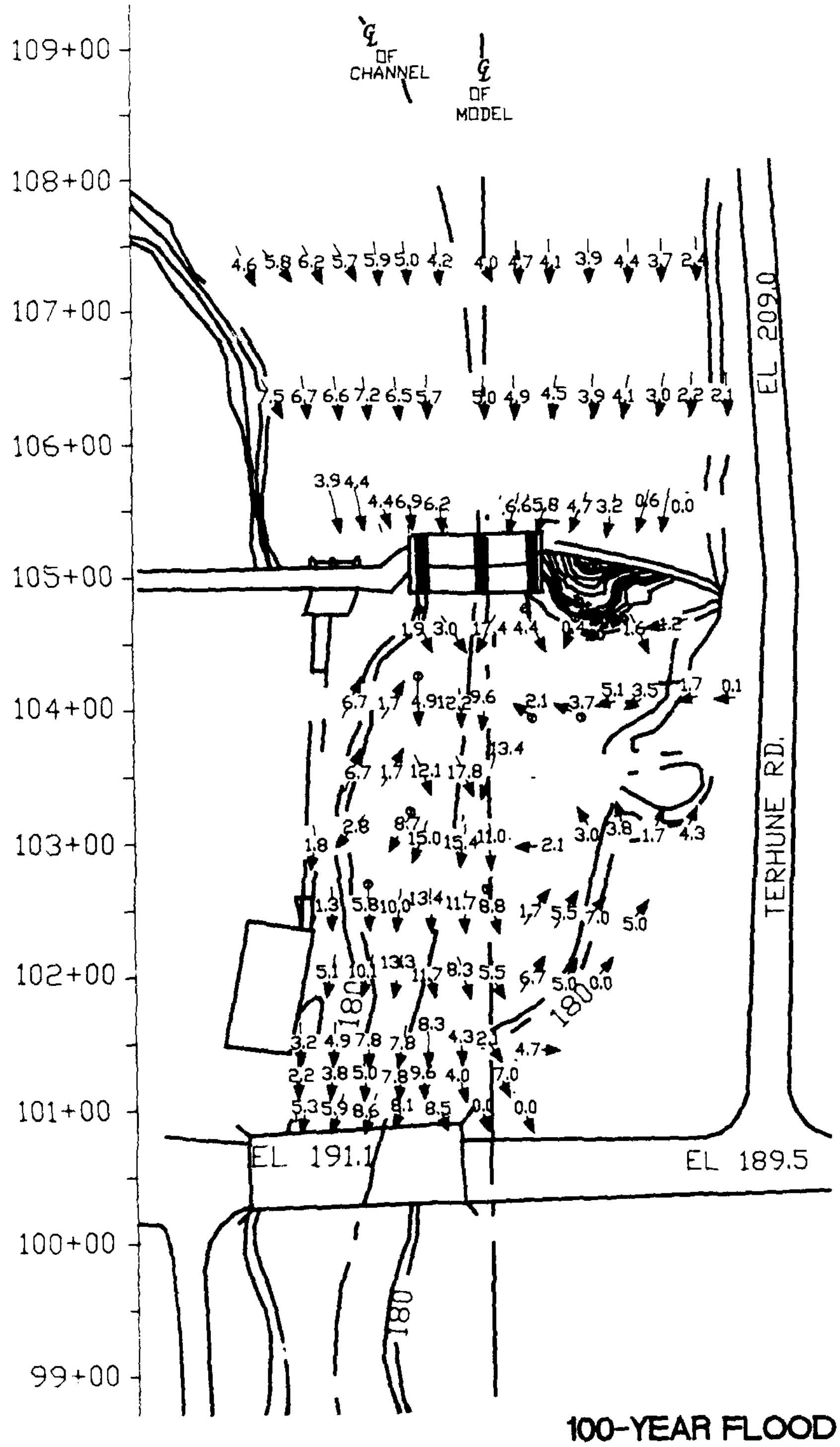


PLATE 16
(Sheet 2 of 3)

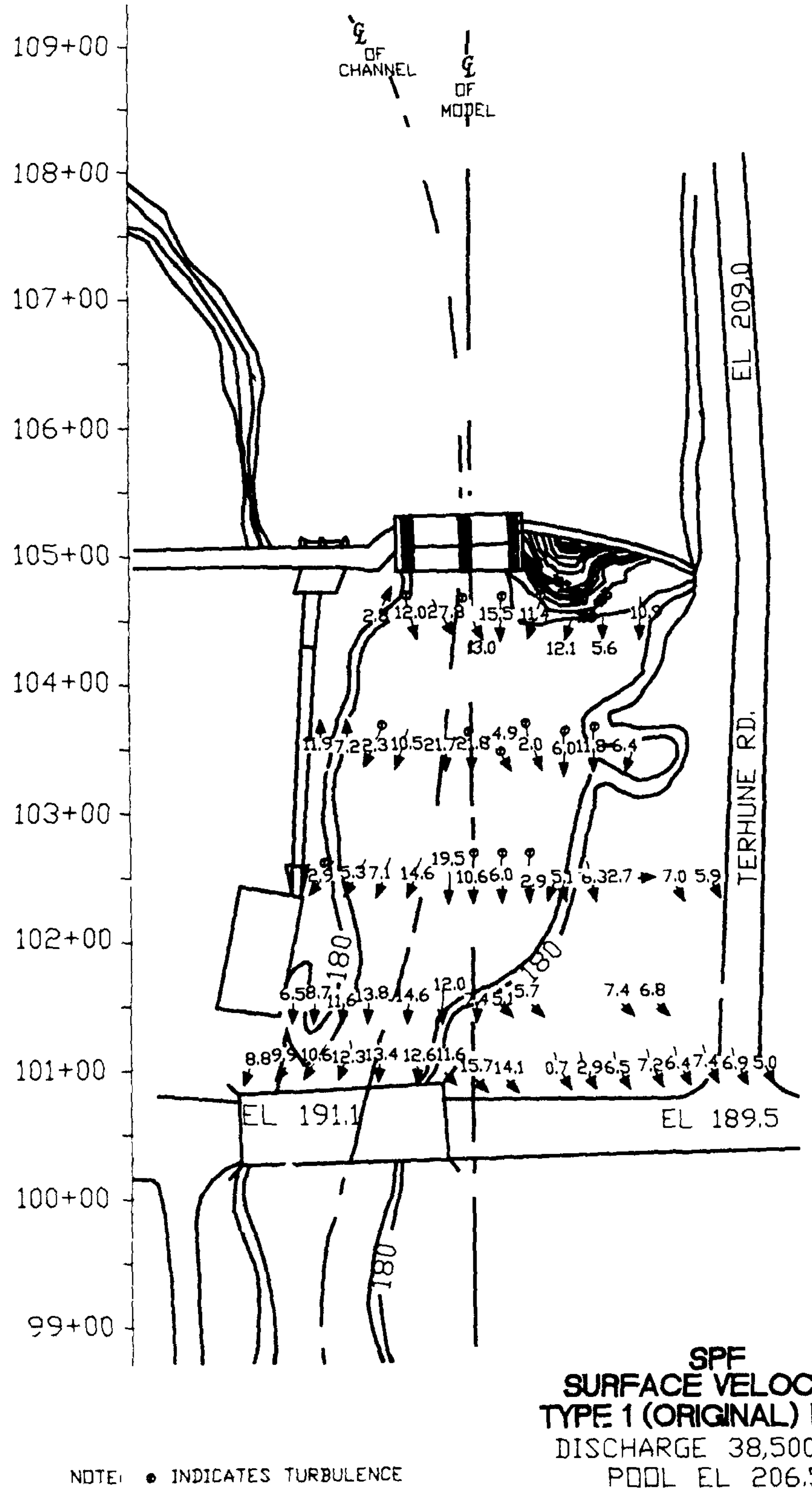


100-YEAR FLOOD
BOTTOM VELOCITIES
TYPE 1 (ORIGINAL) DESIGN

DISCHARGE 21,500 CFS
POOL EL 202.9
MAX M TAILWATER EL 194.5

NOTE: • INDICATES TURBULENCE
VELOCITIES 1 FT ABOVE BOTTOM

PLATE 16
(Sheet 3 of 3)



SPF
SURFACE VELOCITIES
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 38,500 CFS
POOL EL 206.5
MAX M TAILWATER EL 199.0

PLATE 17
(Sheet 1 of 3)

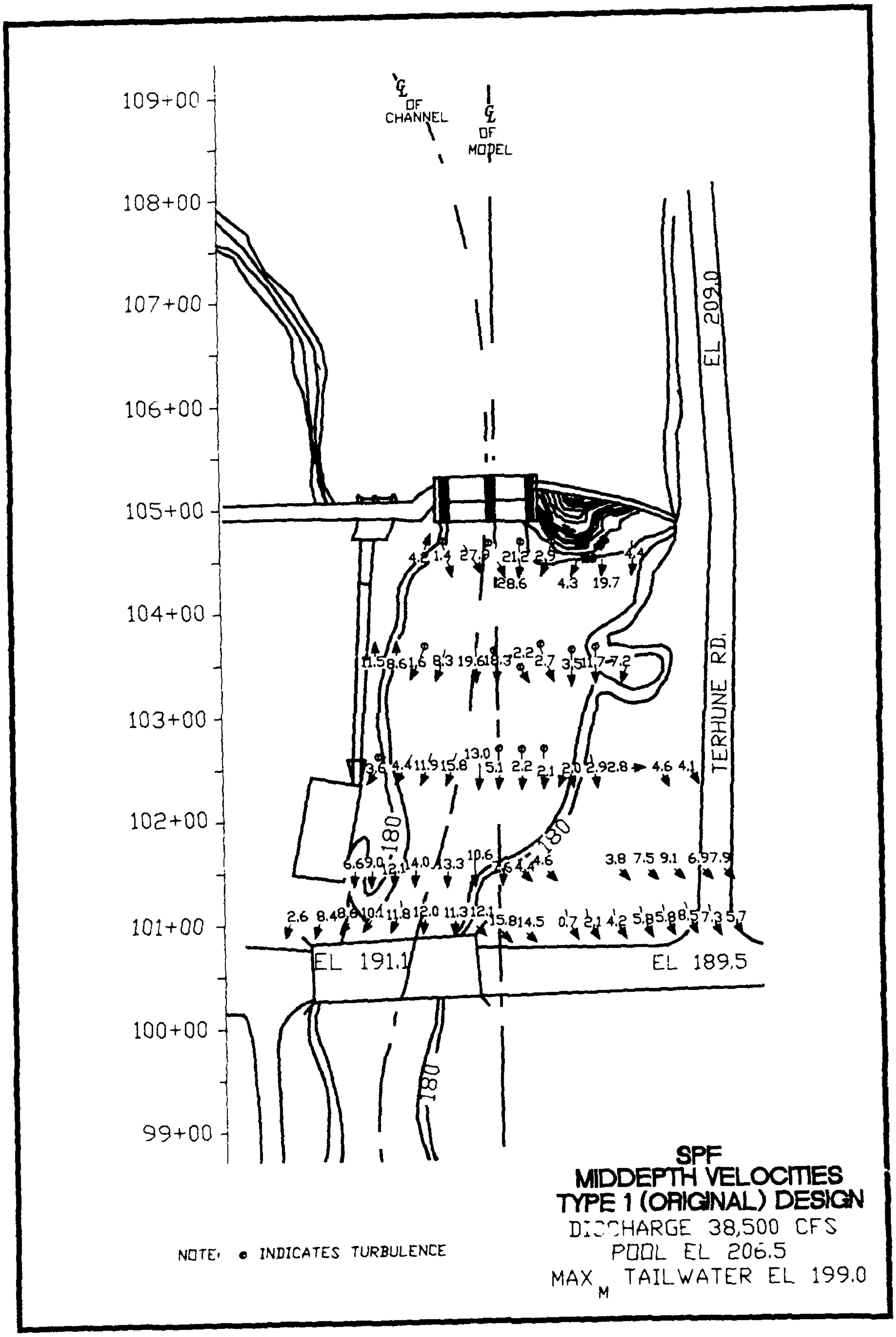


PLATE 17
(Sheet 2 of 3)

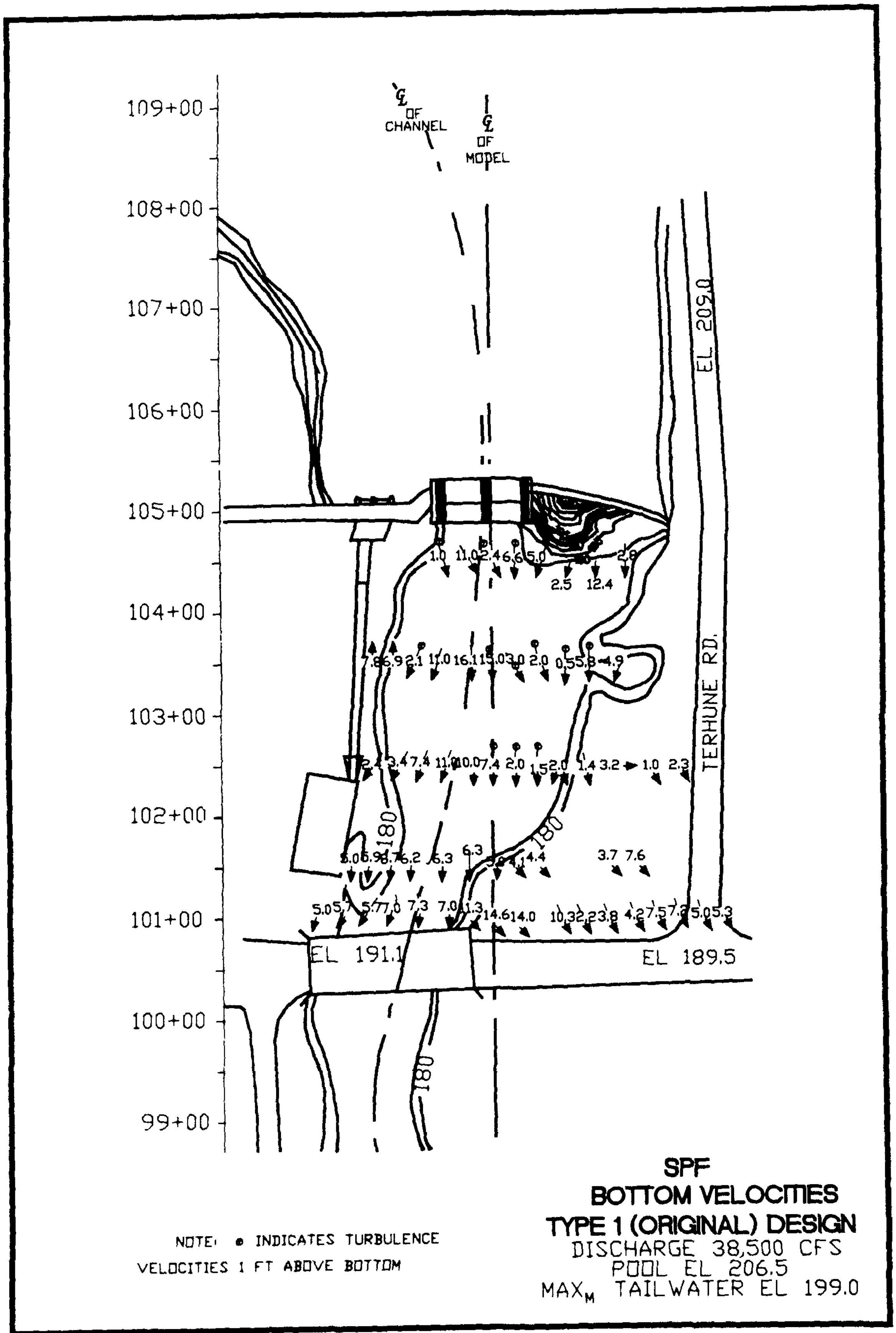
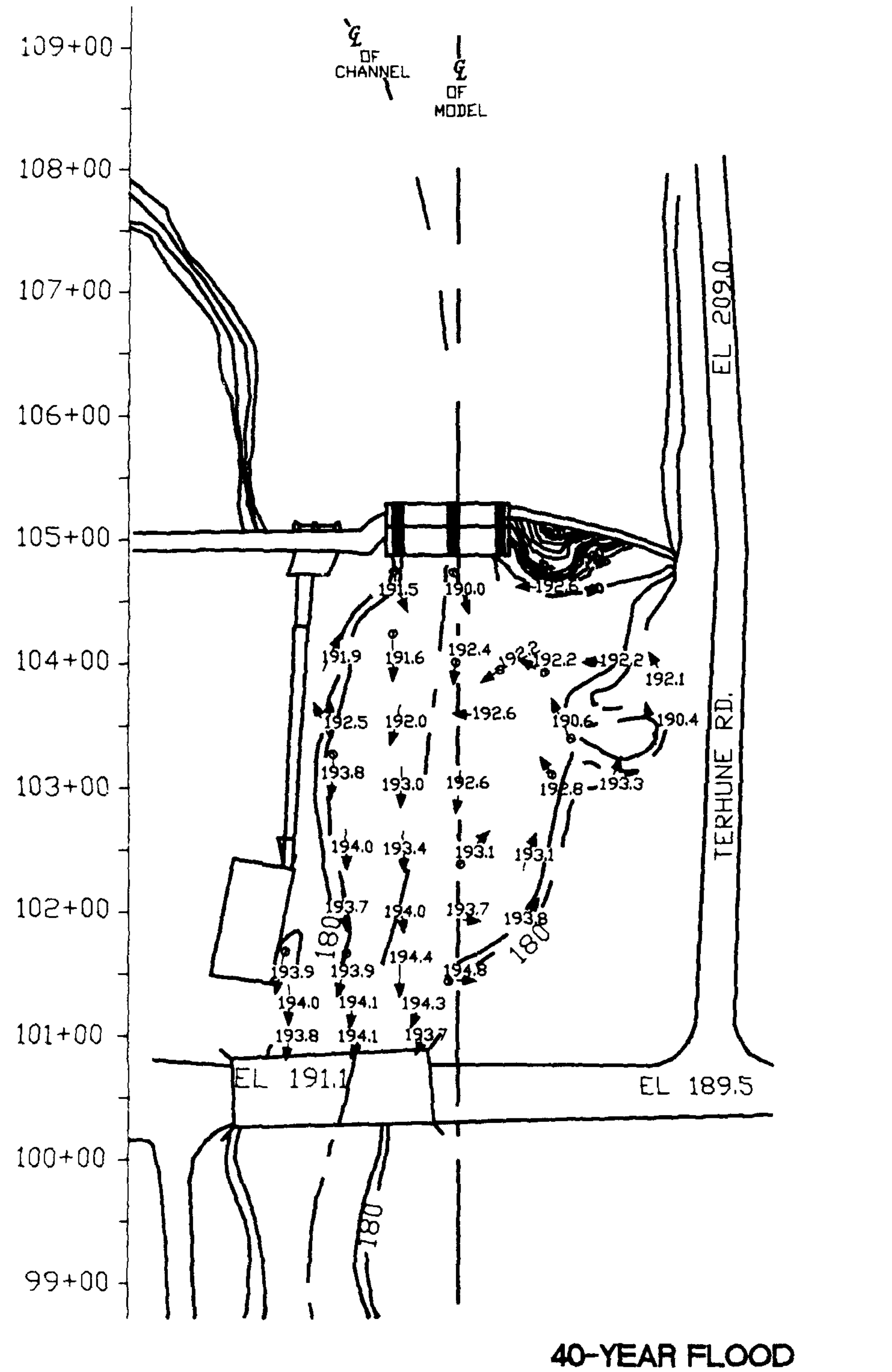
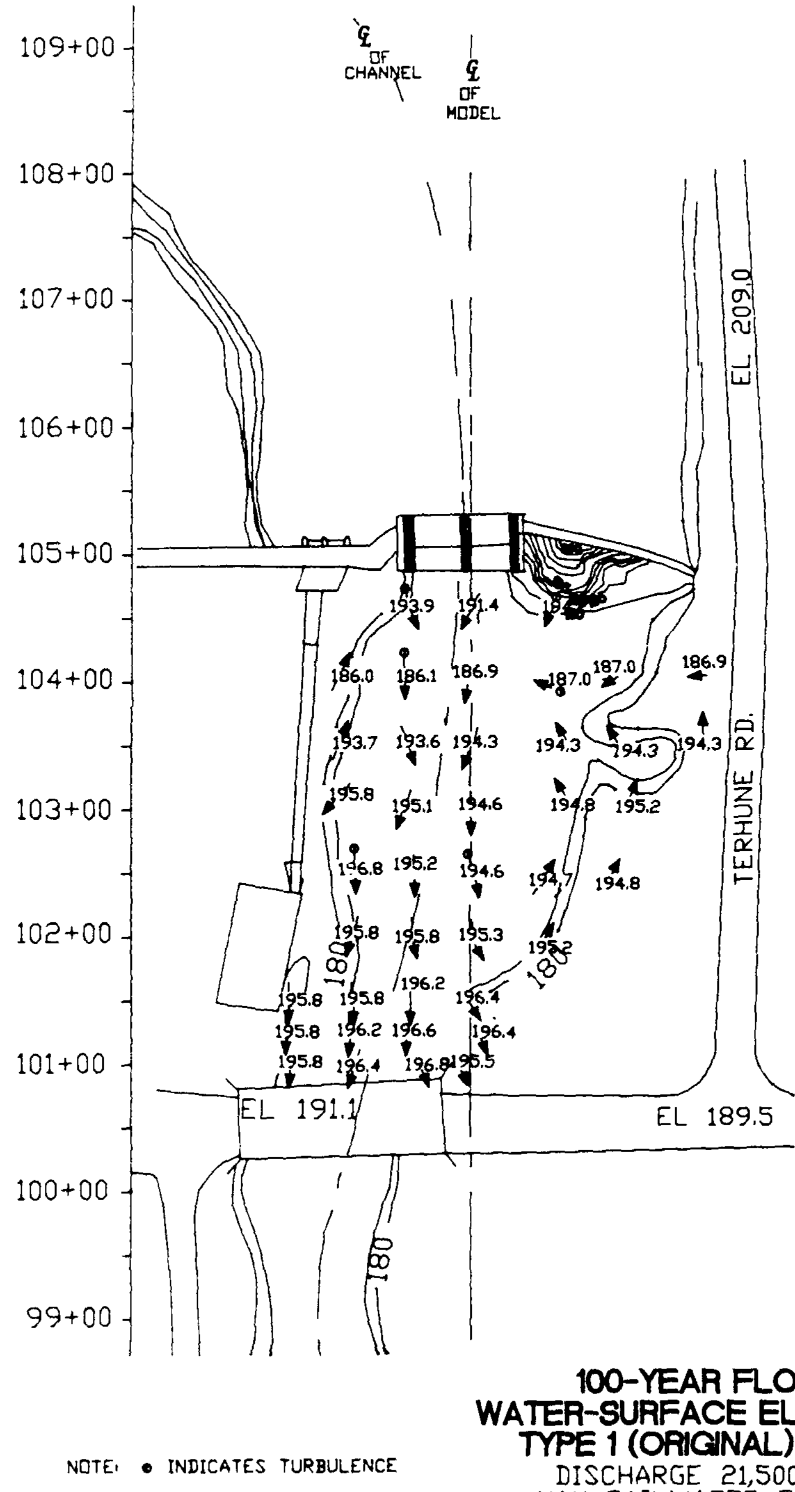


PLATE 17
(Sheet 3 of 3)



40-YEAR FLOOD
WATER-SURFACE ELEVATIONS
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 16,000 CFS
MAX_M TAILWATER EL 192.5

PLATE 18



100-YEAR FLOOD
WATER-SURFACE ELEVATIONS
TYPE 1 (ORIGINAL) DESIGN

DISCHARGE 21,500 CFS
MAX$_M$ TAILWATER EL 194.5

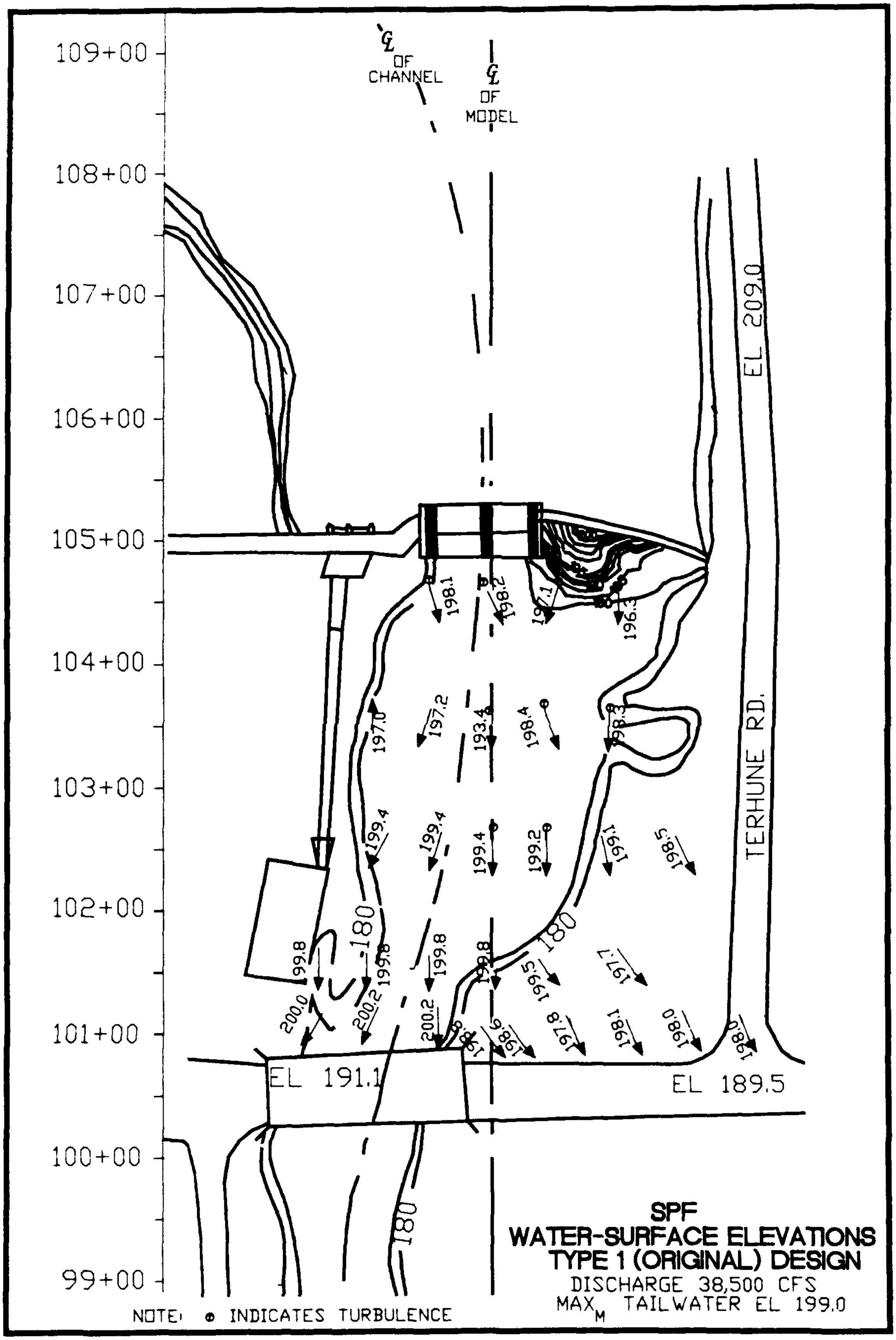
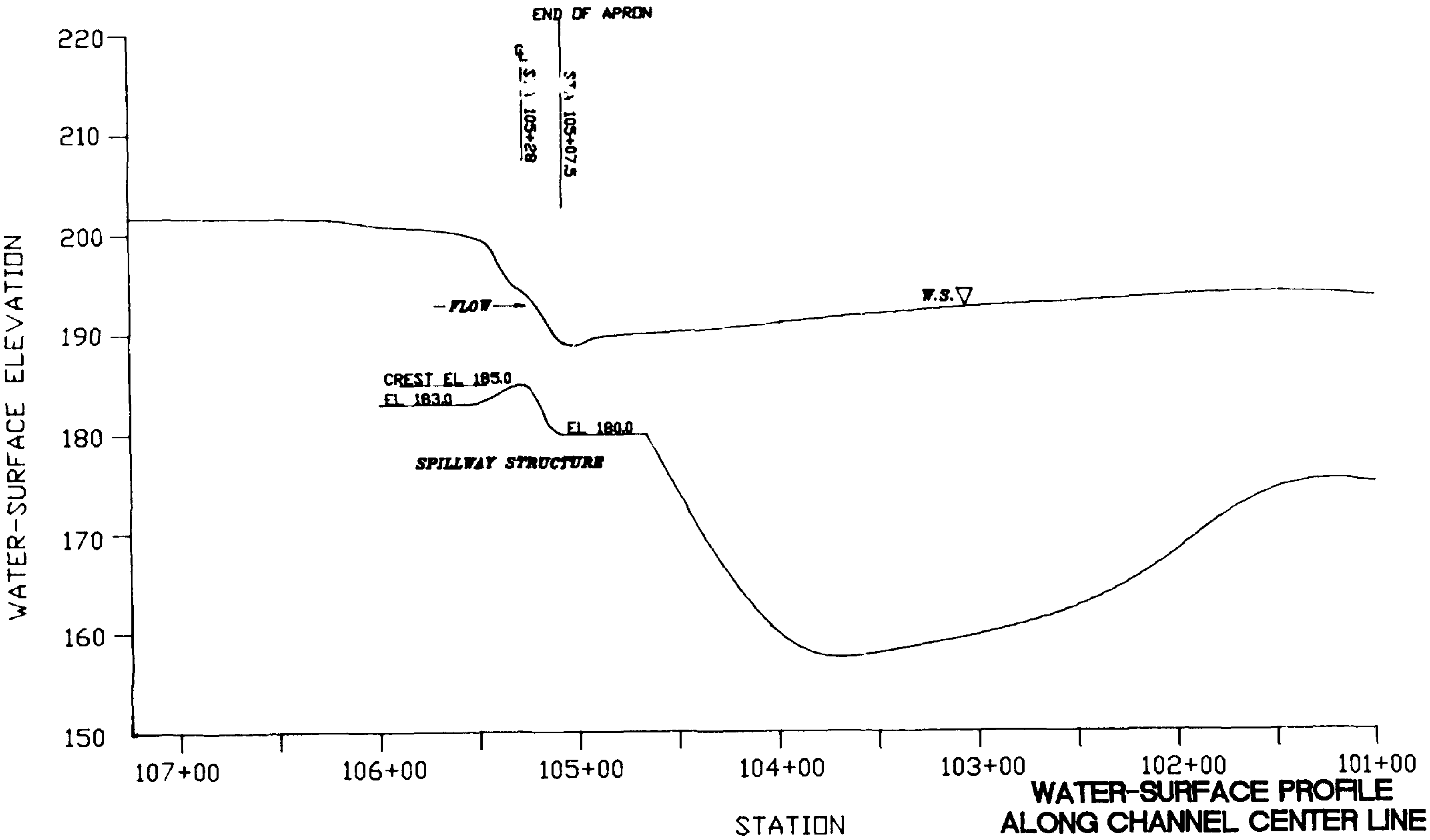

SPF
WATER-SURFACE ELEVATIONS
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 38,500 CFS
MAX$_M$ TAILWATER EL 199.0
NOTE: ⊕ INDICATES TURBULENCE
℄ OF CHANNEL
℄ OF MODEL
TERHUNE RD.
EL 209.0
EL 191.1
EL 189.5
109+00
108+00
107+00
106+00
105+00
104+00
103+00
102+00
101+00
100+00
99+00

PLATE 20



WATER-SURFACE PROFILE ALONG CHANNEL CENTER LINE

TYPE 1 (ORIGINAL) DESIGN

DISCHARGE 16,000 CFS

POOL EL 201.1

MAX_M TAILWATER EL 192.5

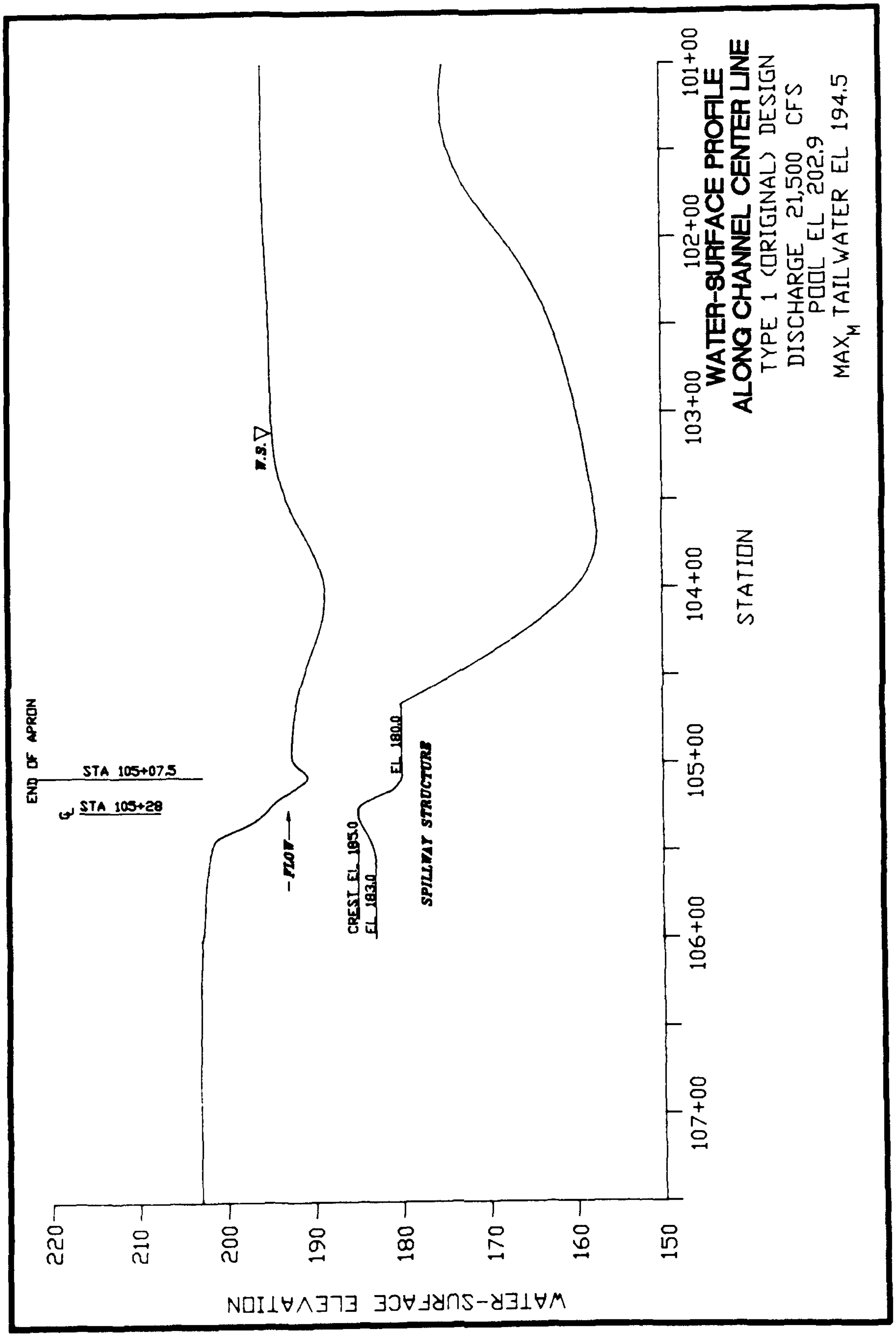
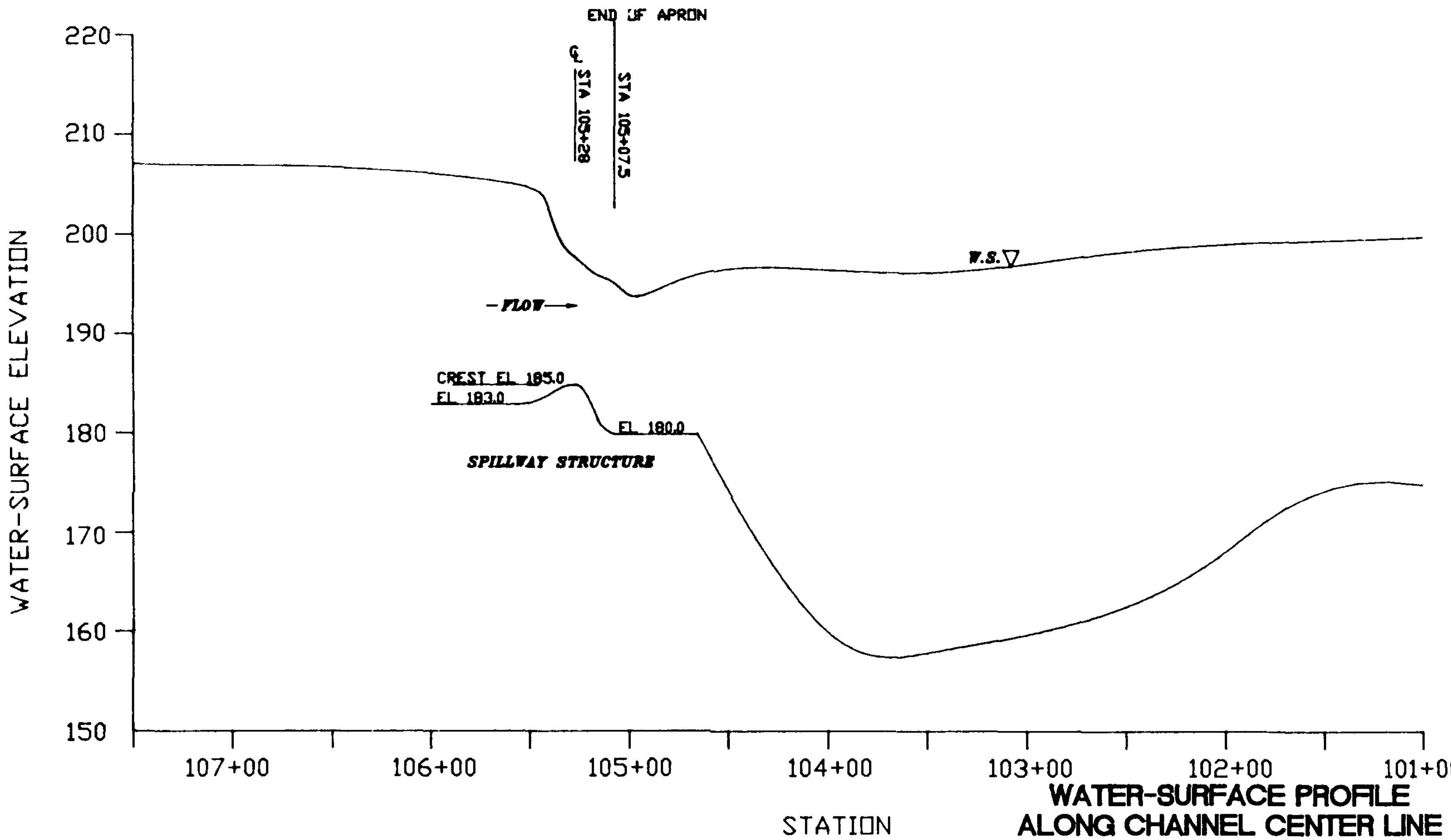


PLATE 21
(Sheet 2 of 3)



WATER-SURFACE PROFILE ALONG CHANNEL CENTER LINE

TYPE 1 (ORIGINAL) DESIGN

DISCHARGE 38,500 CFS

POOL EL 206.5

MAX_M TAILWATER EL 199.0

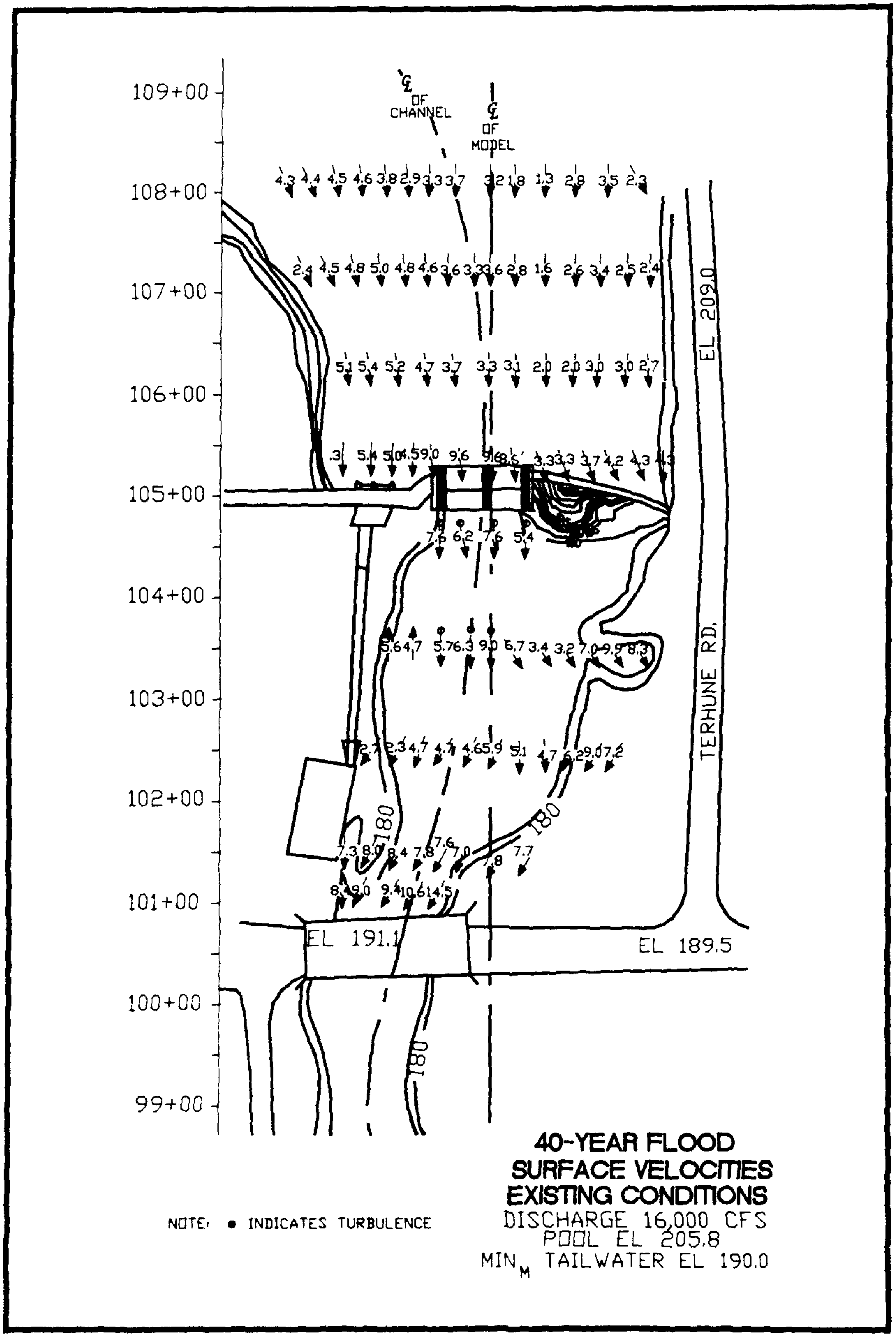


PLATE 22
(Sheet 1 of 3)

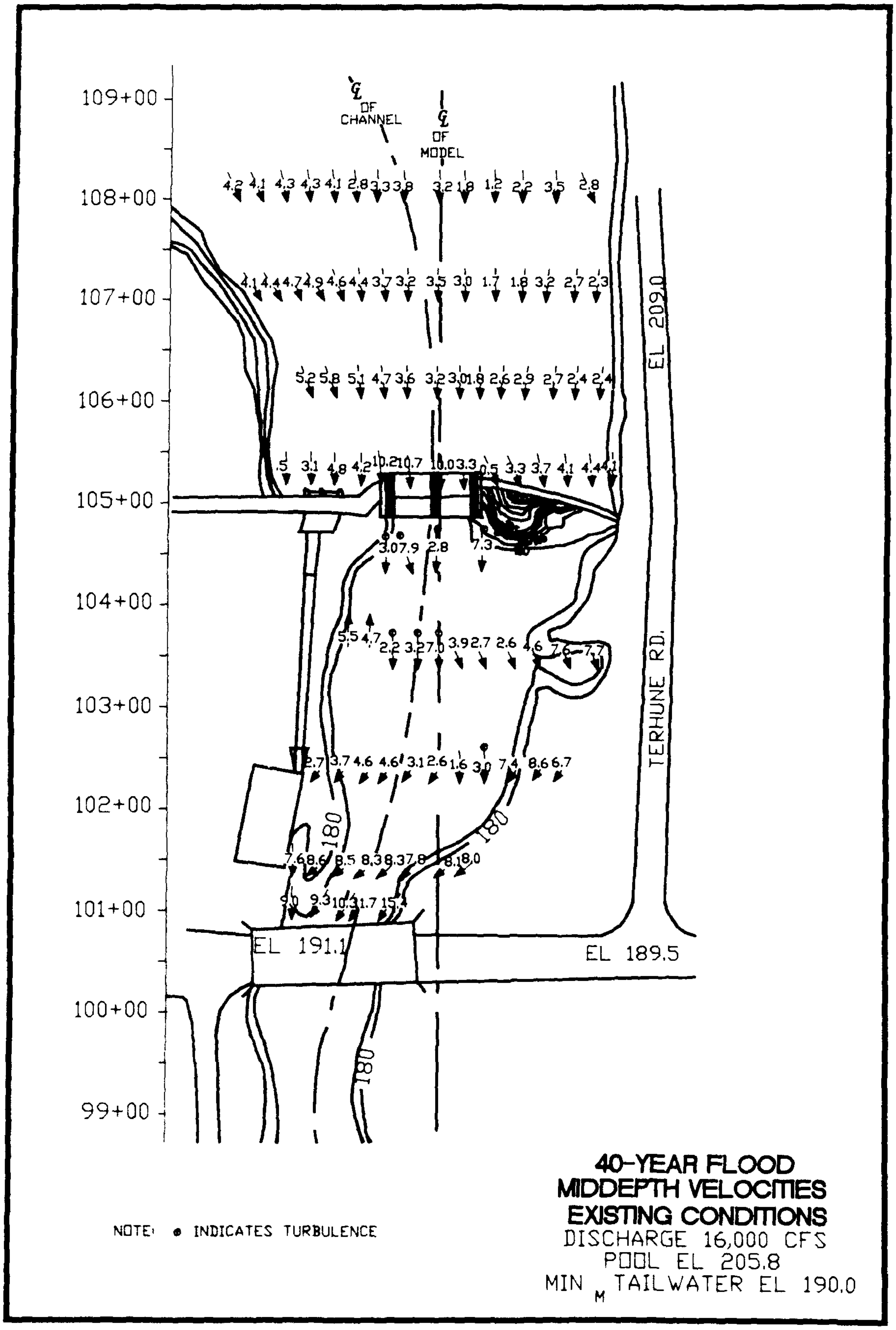


PLATE 22
(Sheet 2 of 3)

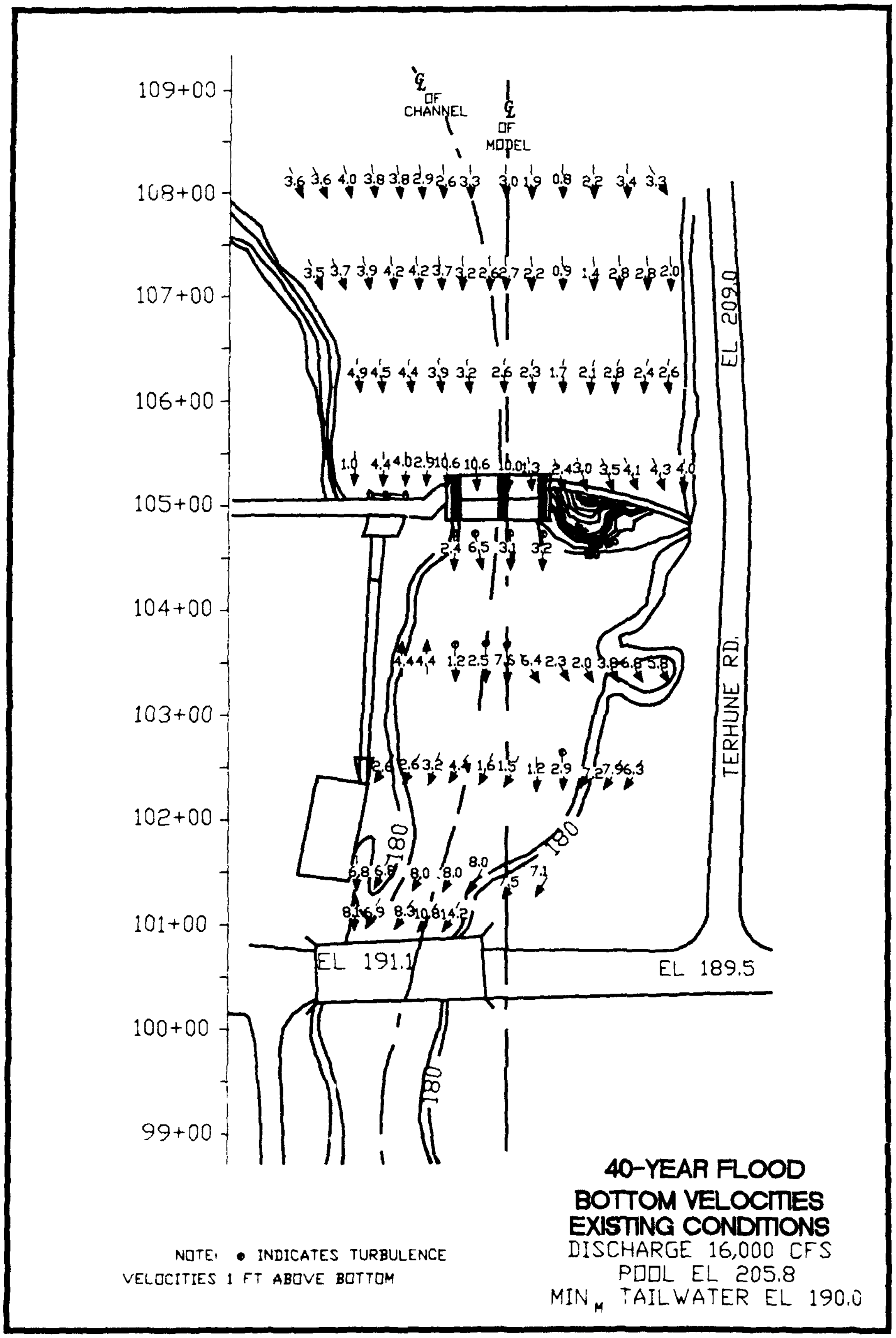
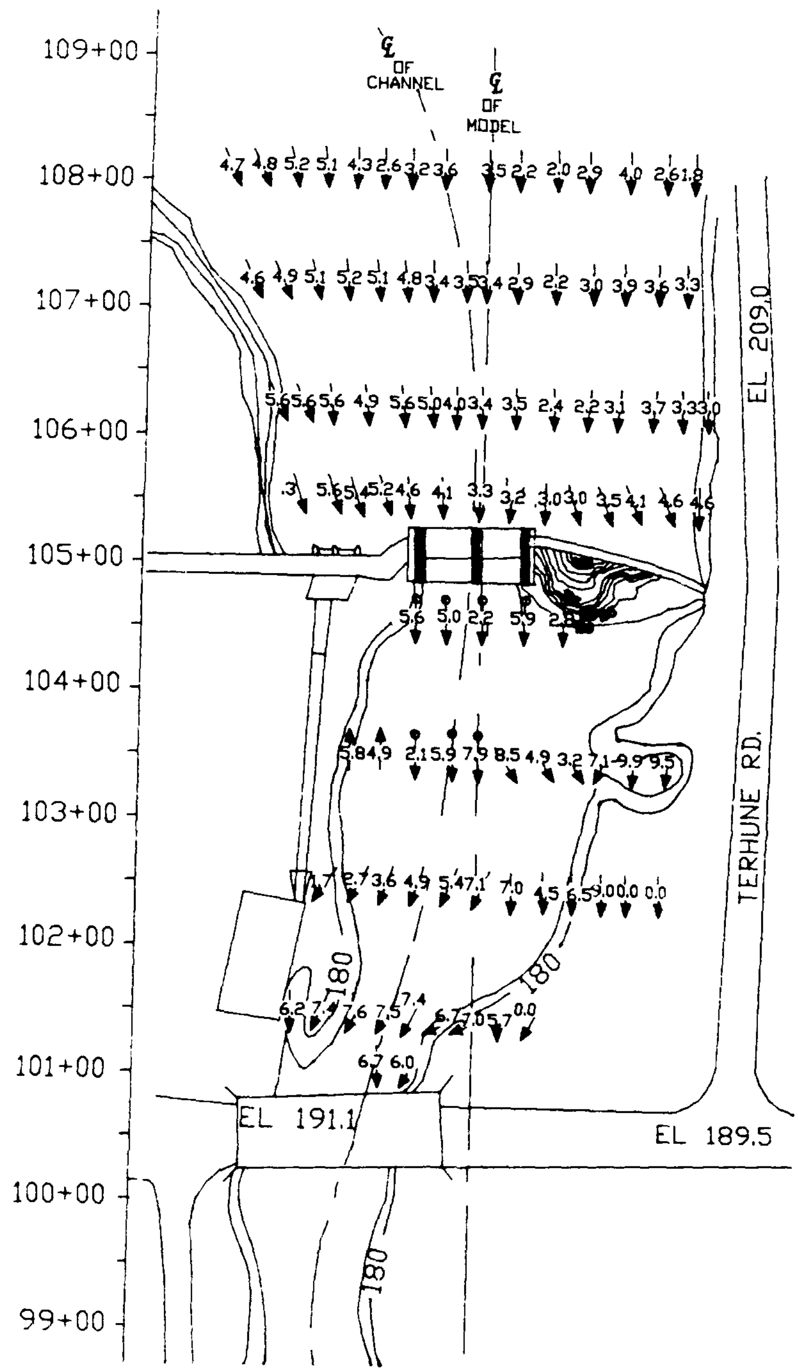


PLATE 22
(Sheet 3 of 3)



NOTE: ● INDICATES TURBULENCE

100-YEAR FLOOD
SURFACE VELOCITIES
EXISTING CONDITIONS
DISCHARGE 21,500 CFS
POOL EL 206.5
MIN$_M$ TAILWATER EL 192.0

PLATE 23
(Sheet 1 of 3)

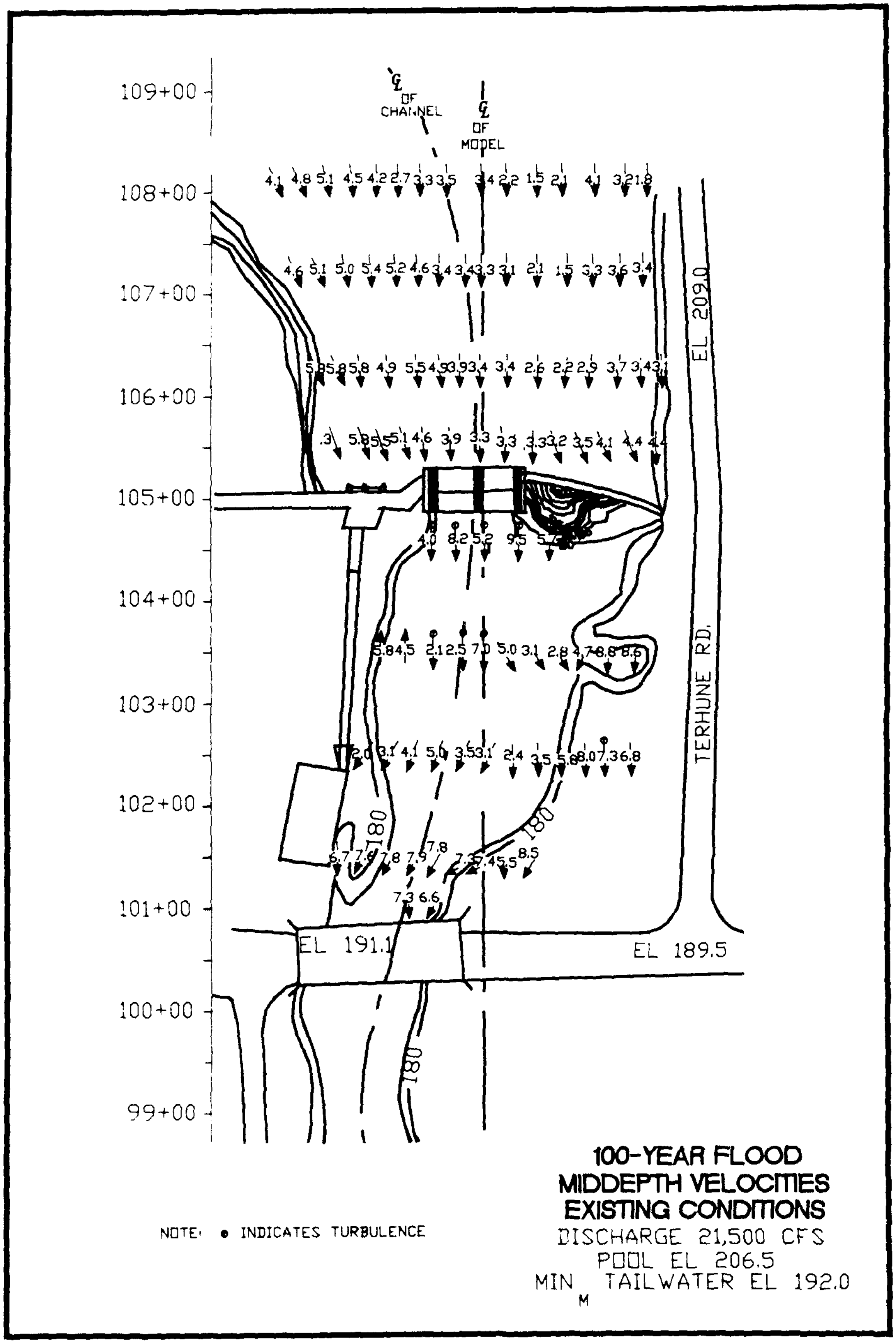
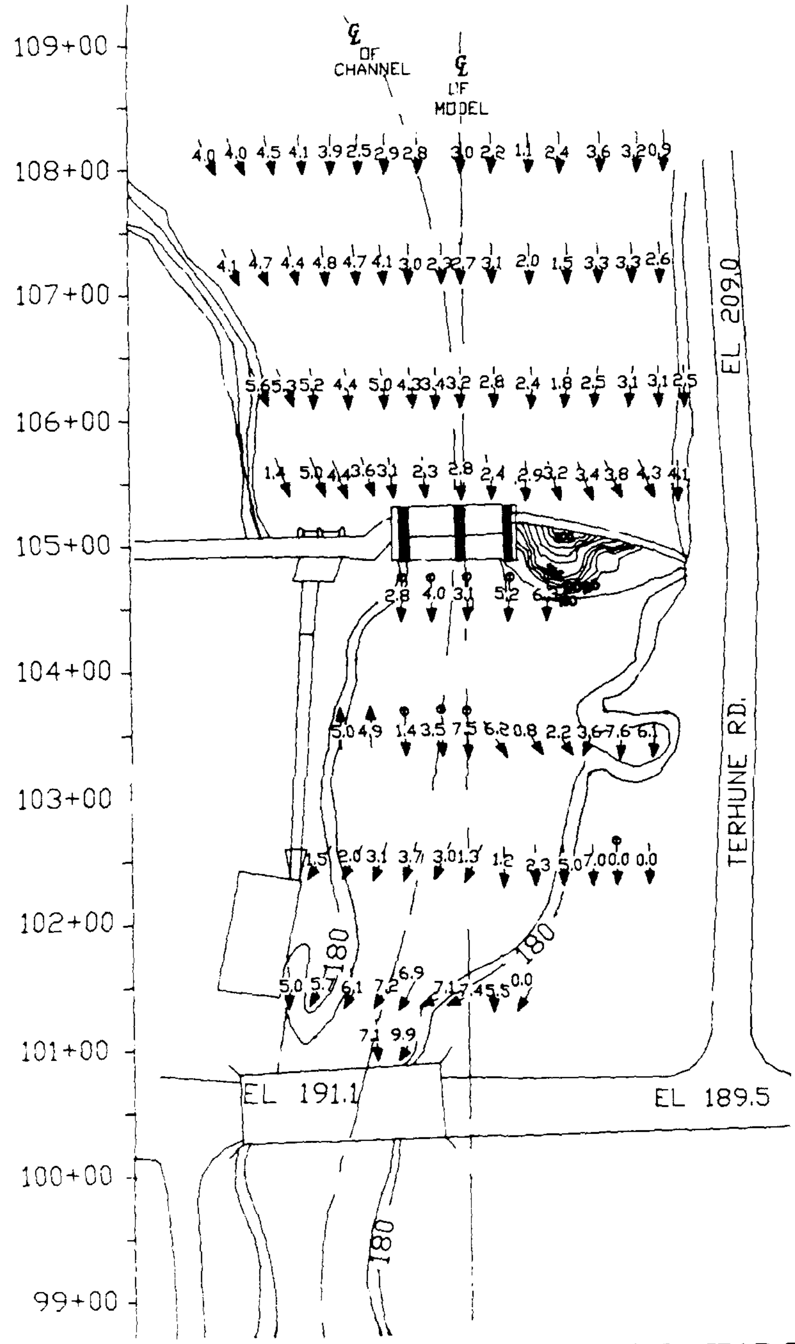


PLATE 23
(Sheet 2 of 3)

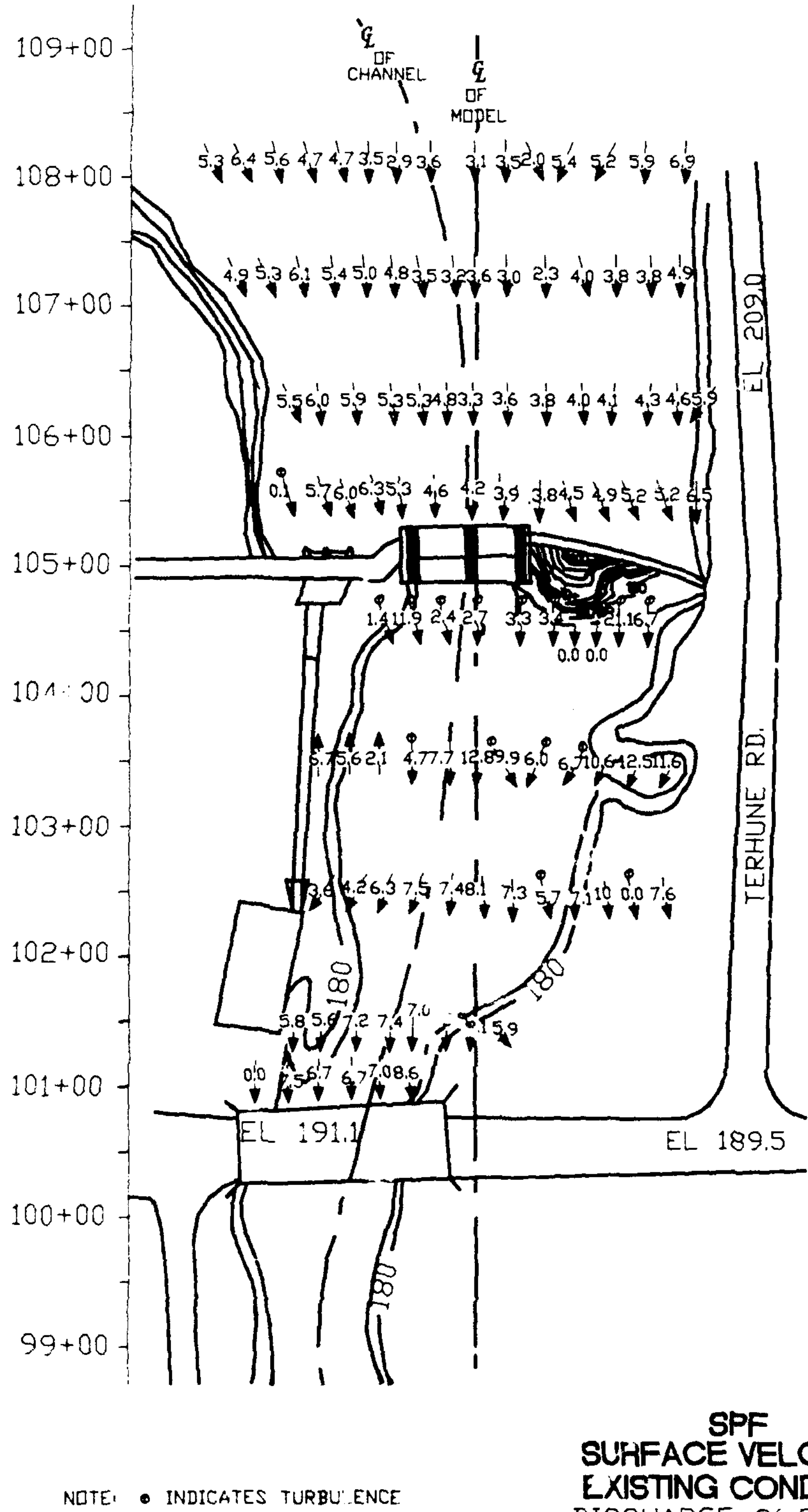


NOTE: ● INDICATES TURBULENCE
VELOCITIES 1 FT ABOVE BOTTOM

**100-YEAR FLOOD
BOTTOM VELOCITIES
EXISTING CONDITIONS**

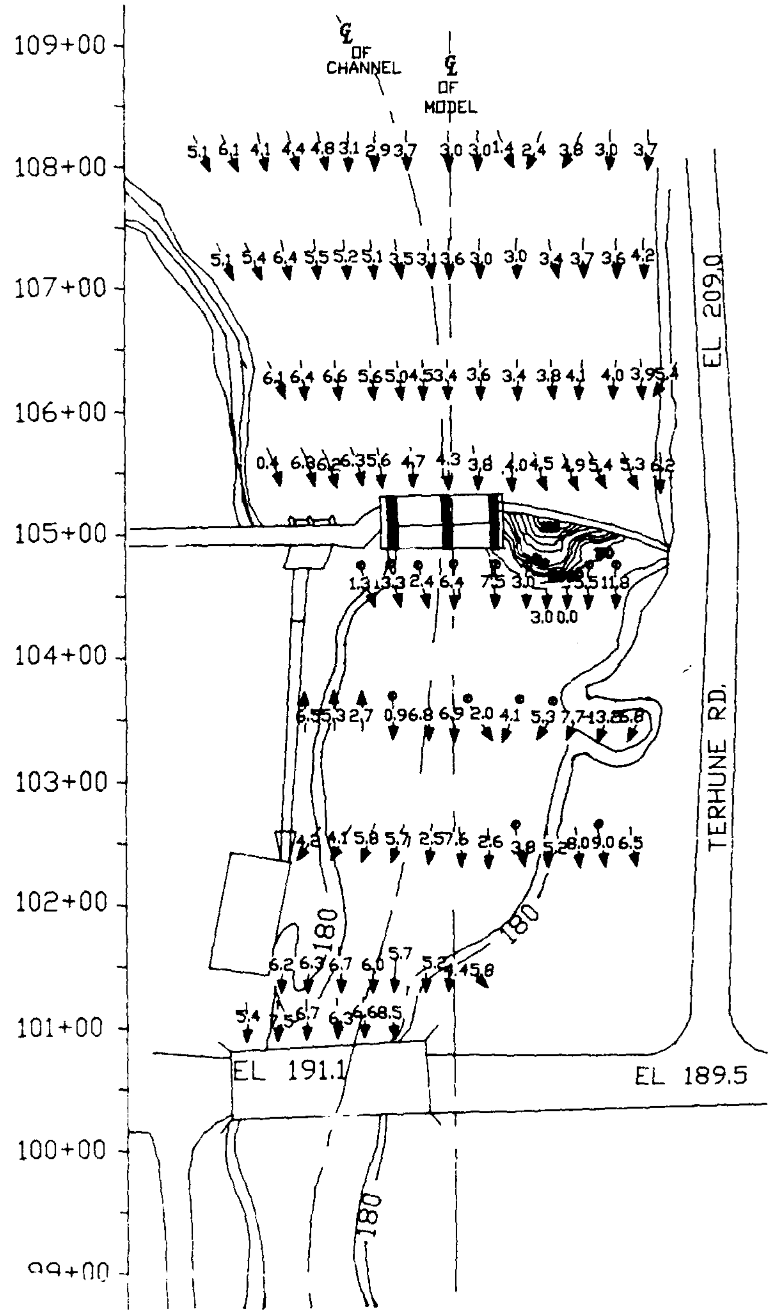
DISCHARGE 21,500 CFS
POOL EL. 206.5
MIN TAILWATER EL 192.0

PLATE 23
(Sheet 3 of 3)



SPF
SURFACE VELOCITIES
EXISTING CONDITIONS
DISCHARGE 38,500 CFS
POOL EL 209.0
MIN$_M$ TAILWATER EL 198.0

PLATE 24
(Sheet 1 of 3)



NOTE: • INDICATES TURBULENCE

SPF
MIDDEPTH VELOCITIES
EXISTING CONDITIONS
DISCHARGE 38,500 CFS
POOL EL 209.0
MIN. TAILWATER EL 198.0

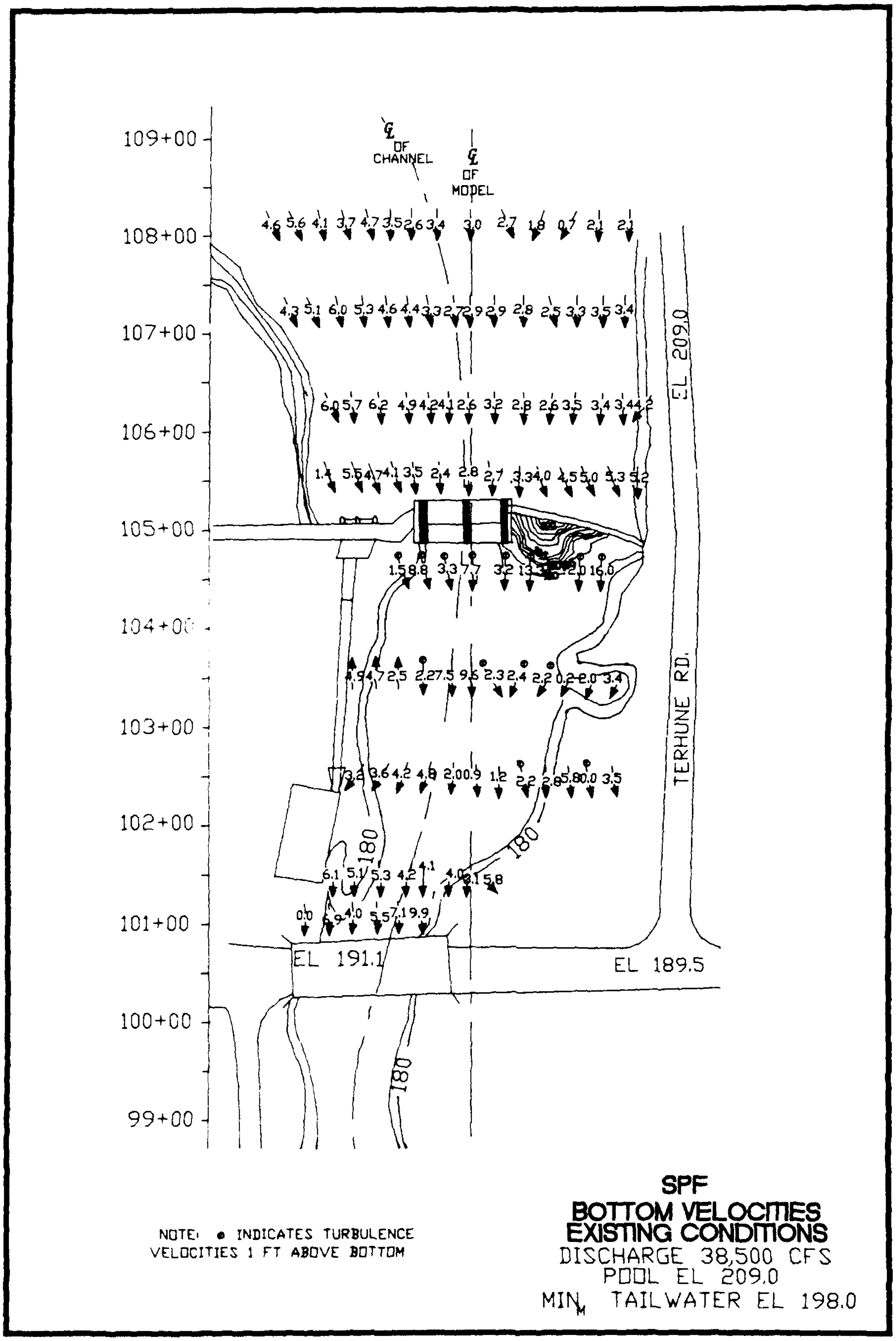
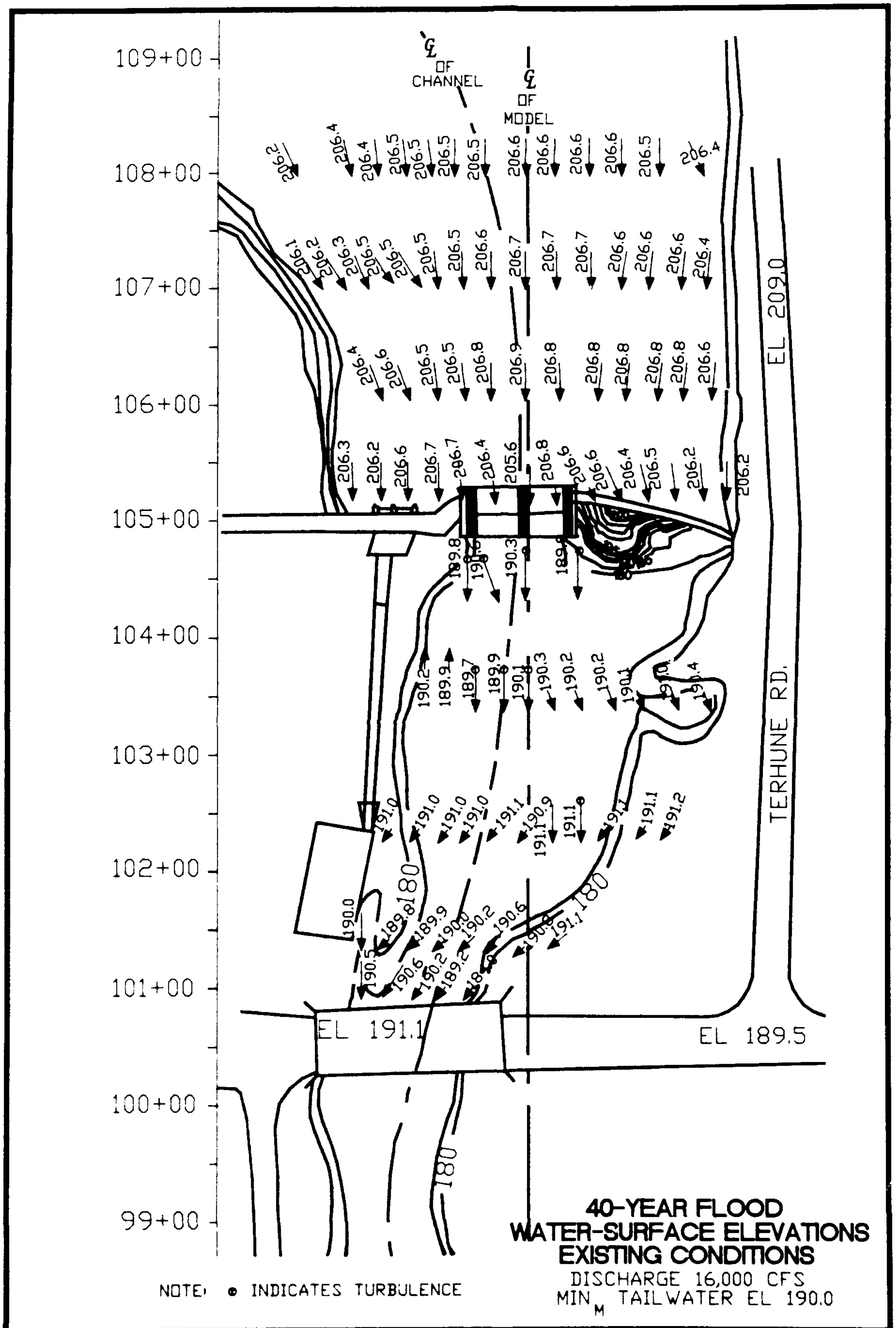


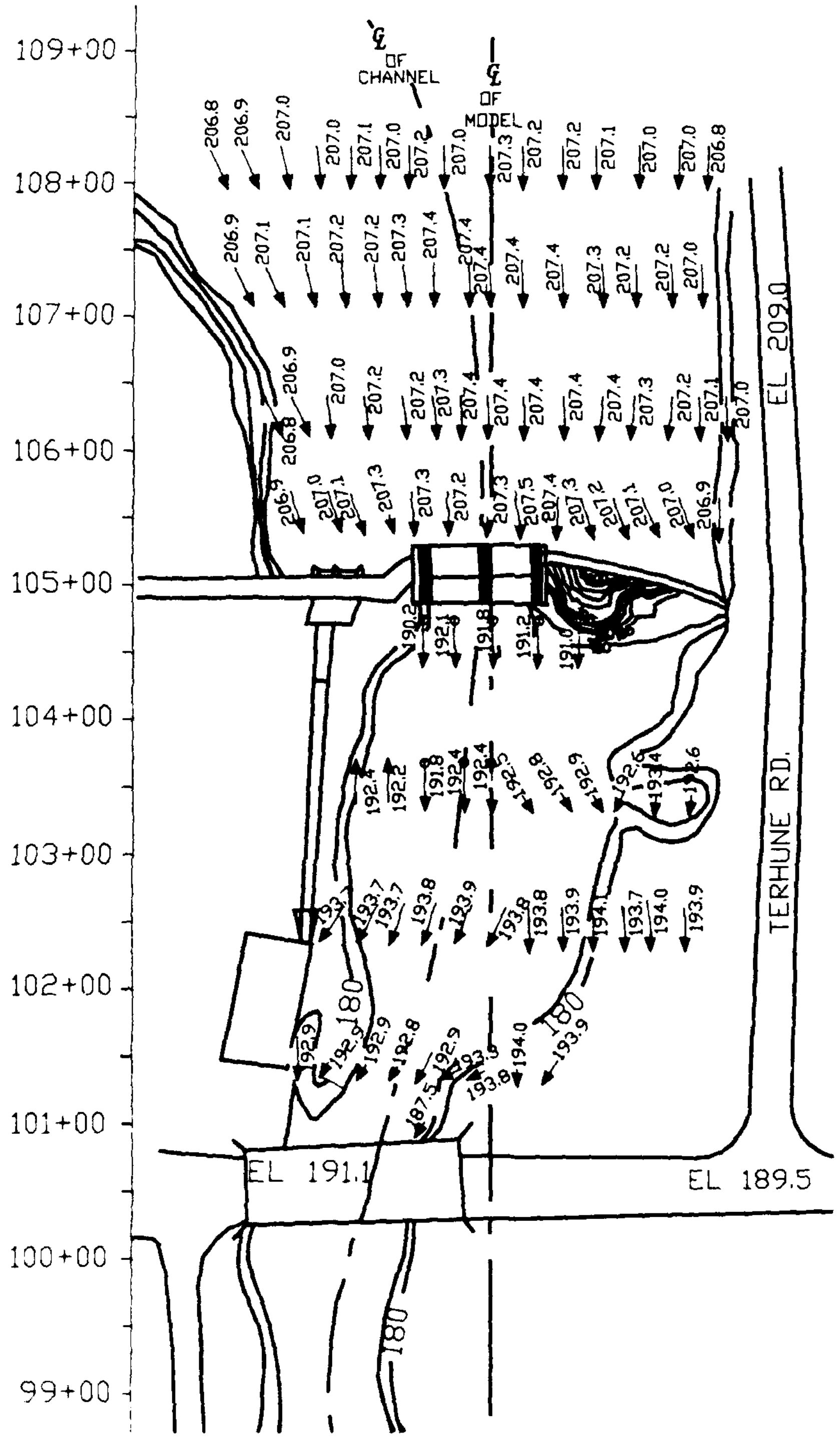
PLATE 24
(Sheet 3 of 3)



40-YEAR FLOOD
WATER-SURFACE ELEVATIONS
EXISTING CONDITIONS

DISCHARGE 16,000 CFS
MIN M TAILWATER EL 190.0

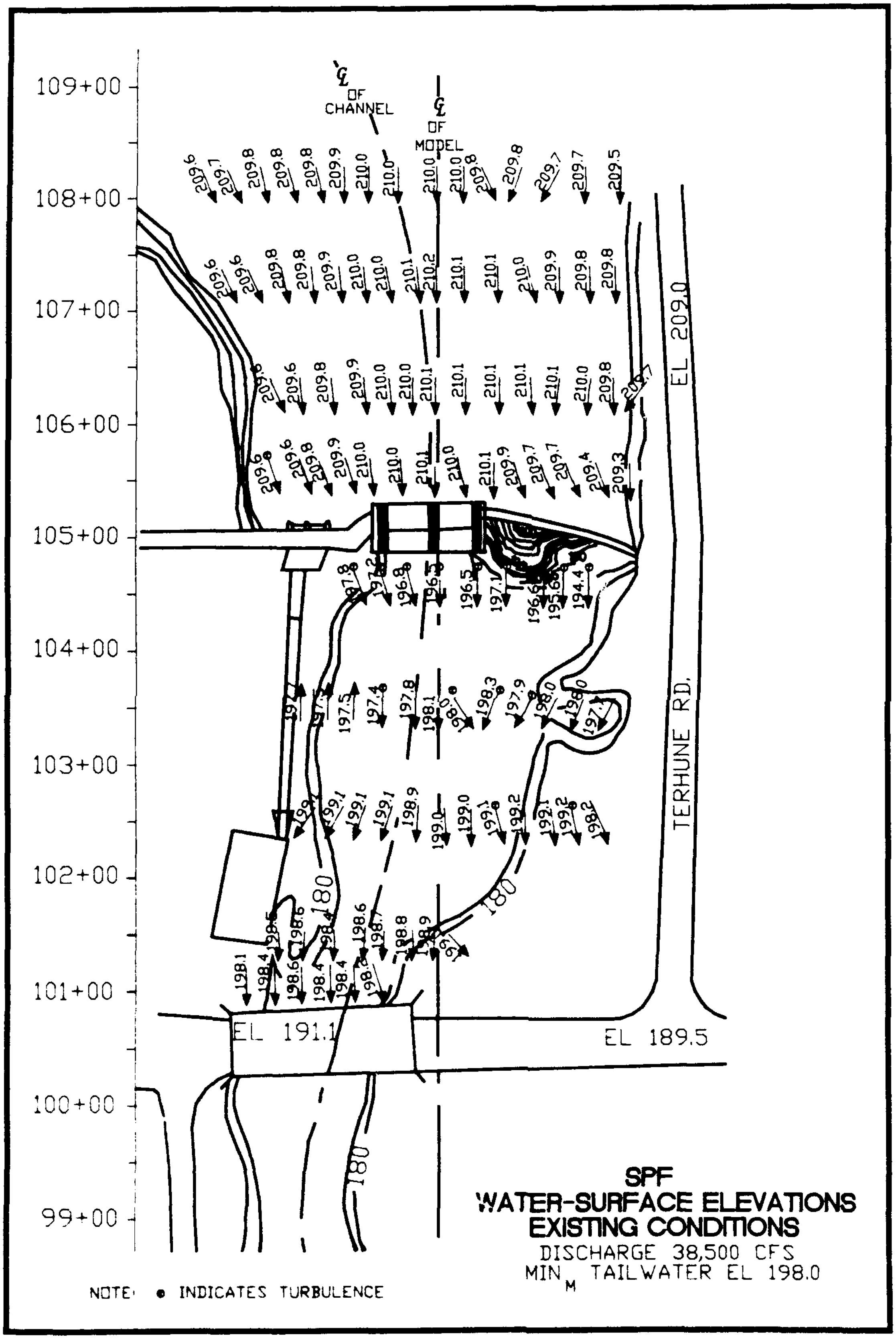
NOTE: ⊛ INDICATES TURBULENCE



NOTE: ● INDICATES TURBULENCE

100-YEAR FLOOD
WATER-SURFACE ELEVATIONS
EXISTING CONDITIONS

DISCHARGE 21,500 CFS
MIN$_M$ TAILWATER EL 192.0



SPF
WATER-SURFACE ELEVATIONS
EXISTING CONDITIONS
DISCHARGE 38,500 CFS
MIN$_M$ TAILWATER EL 198.0

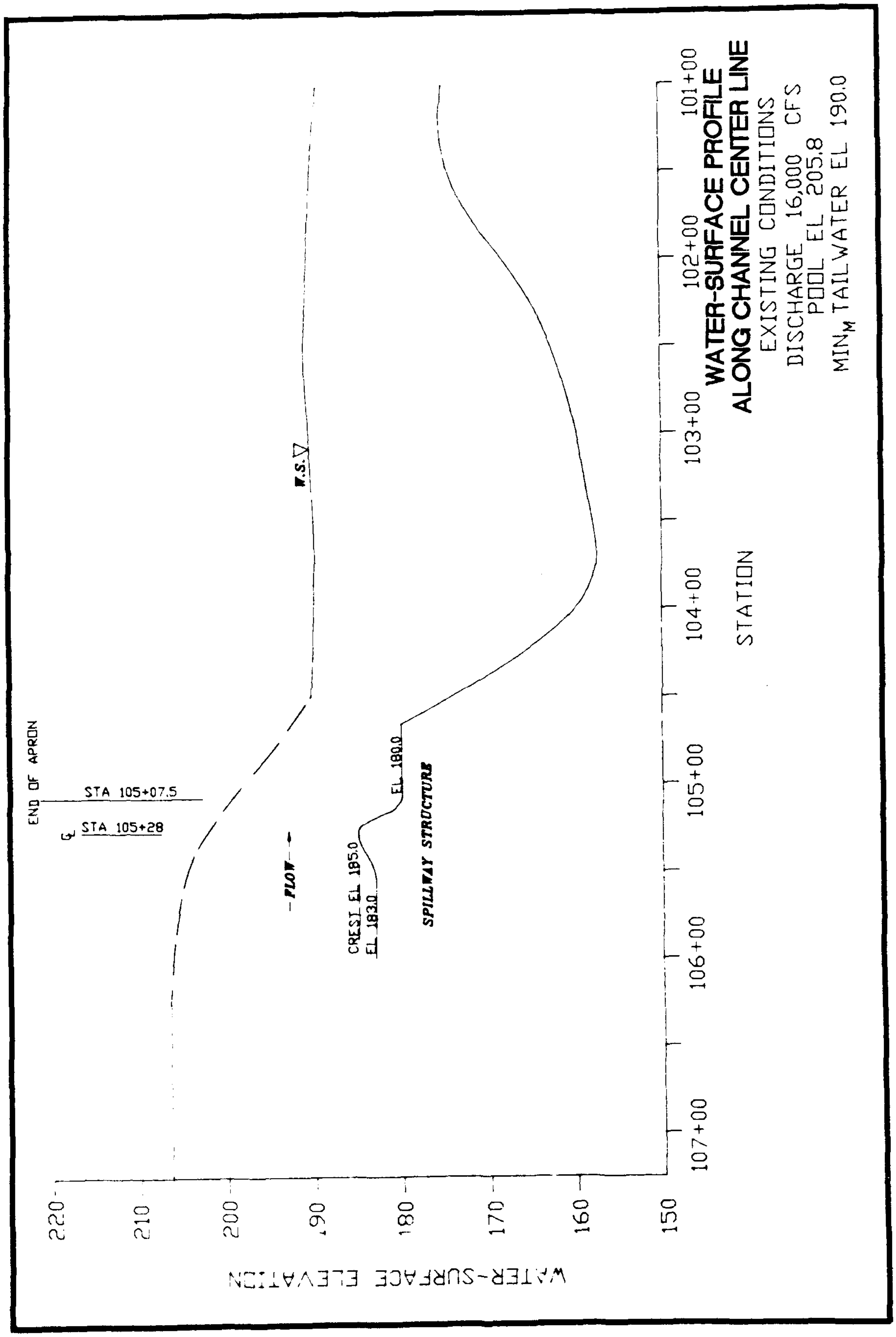
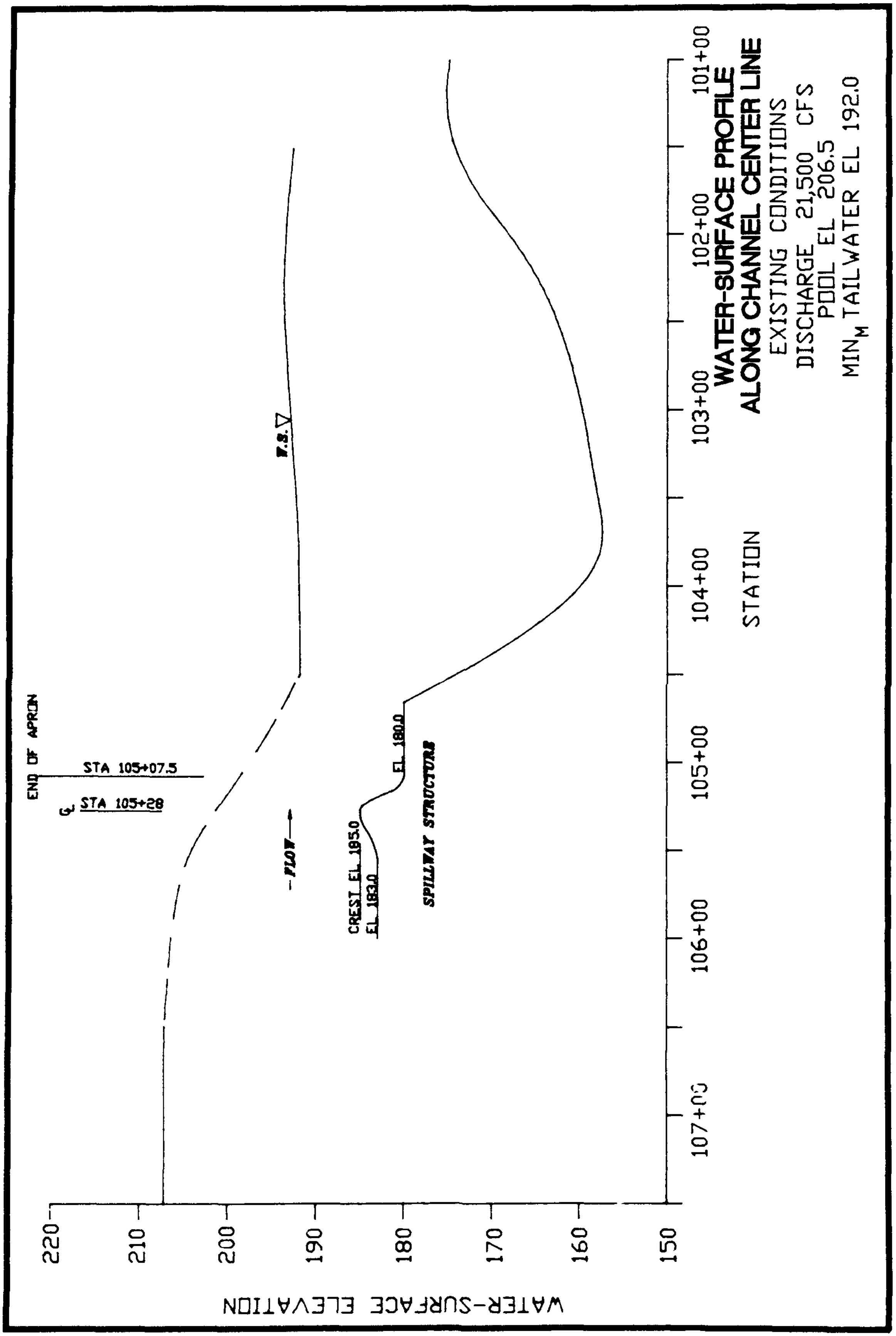


PLATE 28
(Sheet 1 of 3)


WATER-SURFACE PROFILE
ALONG CHANNEL CENTER LINE
EXISTING CONDITIONS
DISCHARGE 21,500 CFS
POOL EL 206.5
MIN$_M$ TAILWATER EL 192.0
WATER-SURFACE ELEVATION
STATION
220
210
200
190
180
170
160
150
107+00
106+00
105+00
104+00
103+00
102+00
101+00
END OF APRON
STA 105+07.5
℄ STA 105+28
W.S.
FLOW
CREST EL 185.0
EL 183.0
EL 180.0
SPILLWAY STRUCTURE

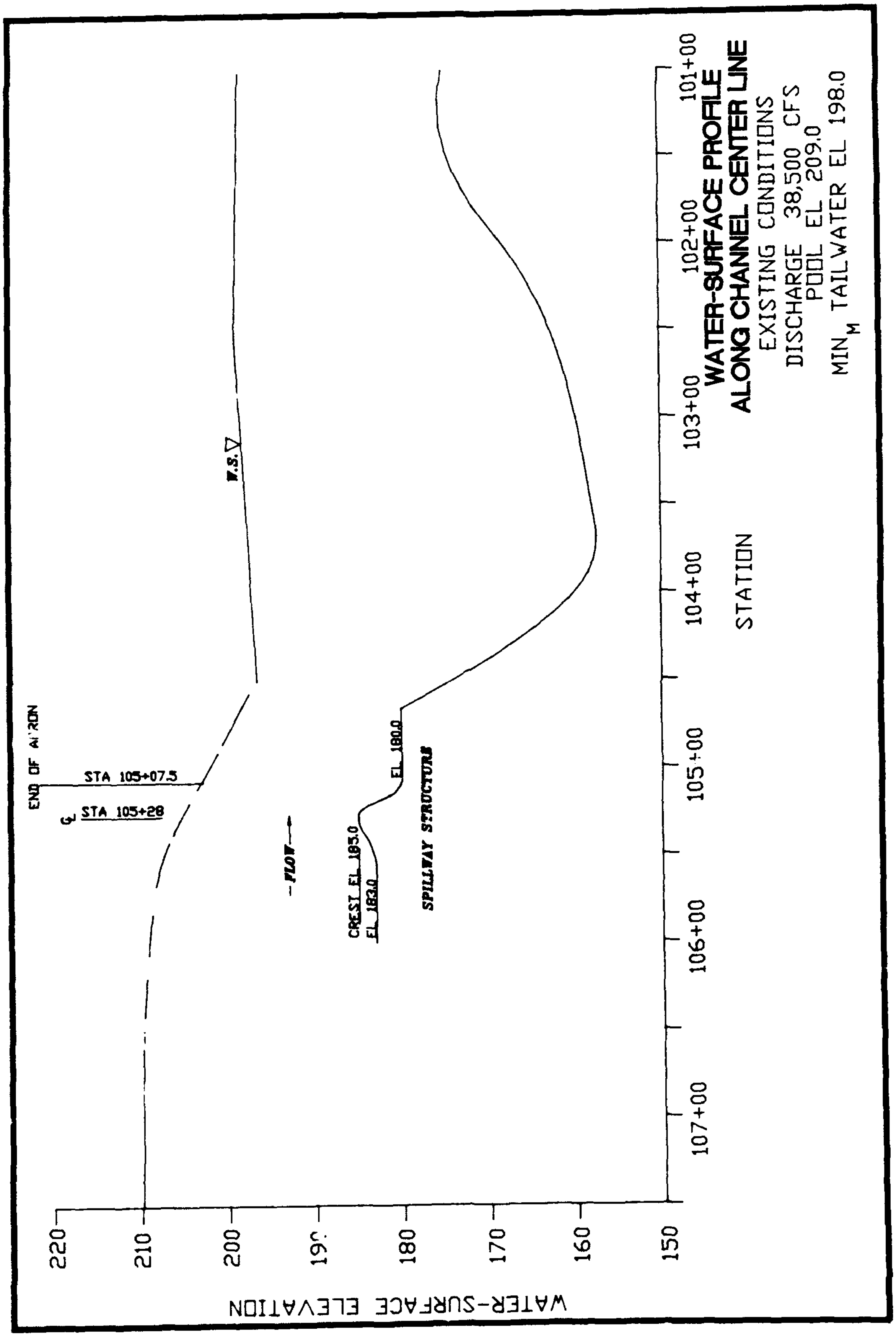
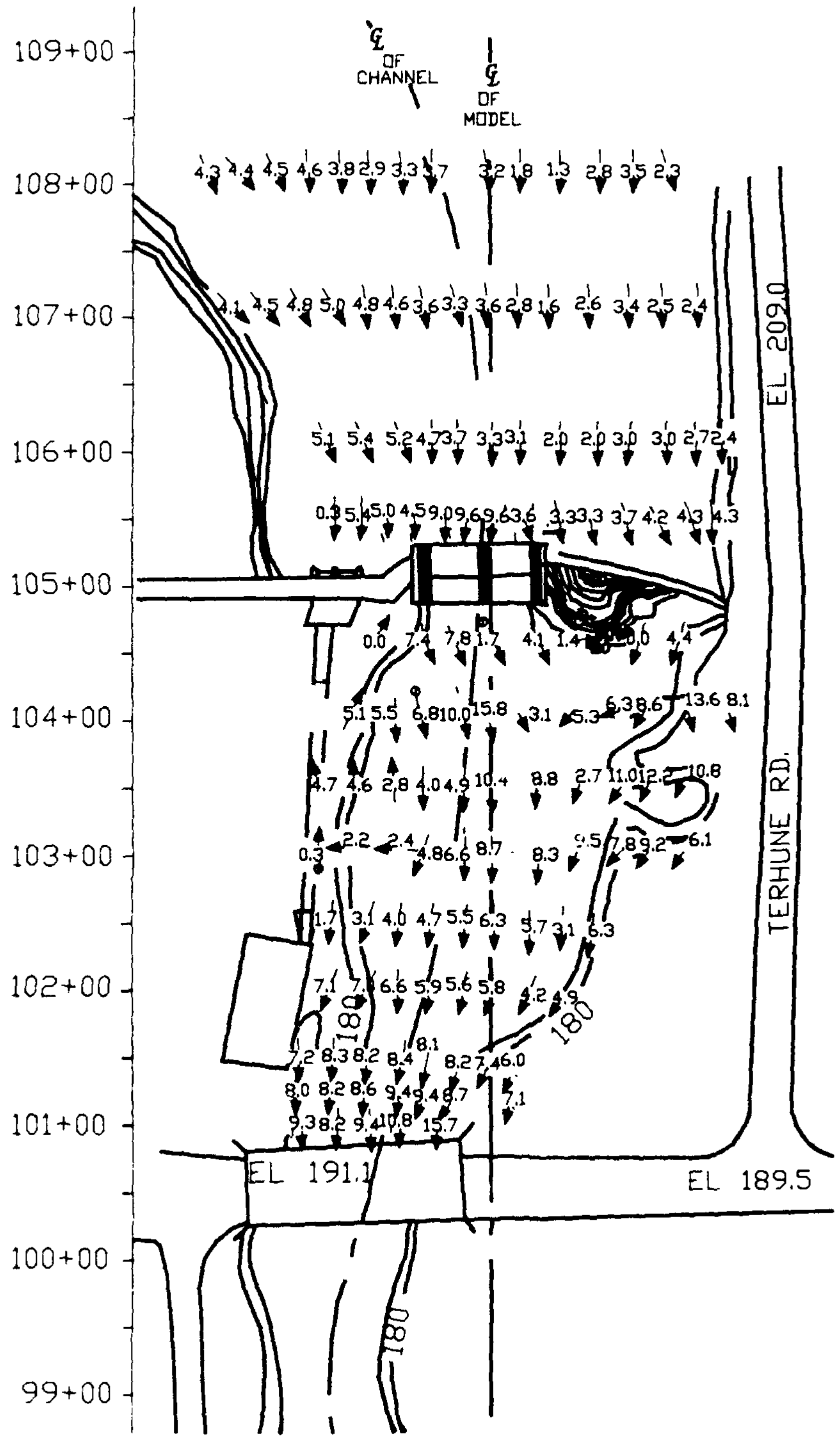


PLATE 28
(Sheet 3 of 3)

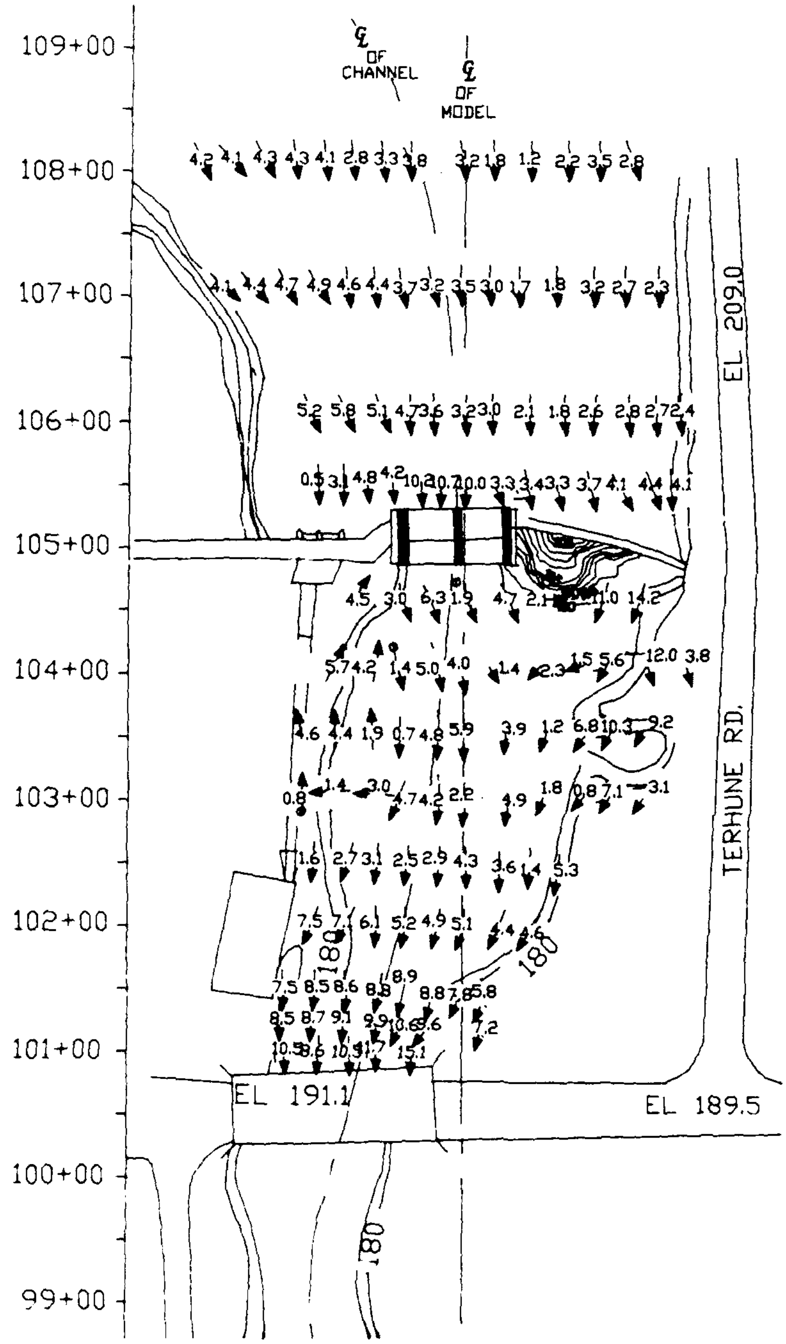


NOTE: • INDICATES TURBULENCE

40-YEAR FLOOD
SURFACE VELOCITIES
EXISTING CONDITIONS

DISCHARGE 16,000 CFS
POOL EL 205.8
MAX_M TAILWATER EL 192.5

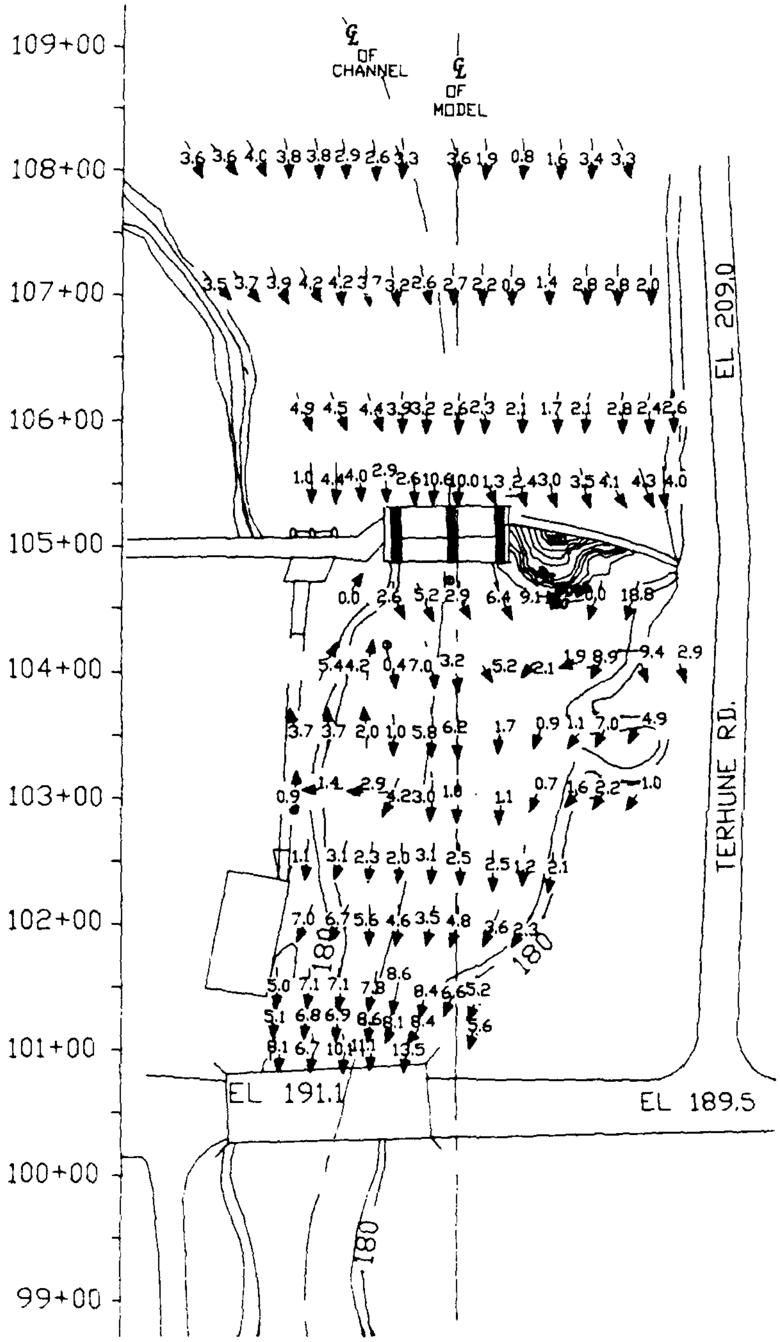
PLATE 29
(Sheet 1 of 3)



NOTE: • INDICATES TURBULENCE

40-YEAR FLOOD
MIDDEPTH VELOCITIES
EXISTING CONDITIONS
DISCHARGE 16,000 CFS
POOL EL 205.8
MAX M TAILWATER EL 192.5

PLATE 29
(Sheet 2 of 3)



NOTE: ● INDICATES TURBULENCE
VELOCITIES 1 FT ABOVE BOTTOM

40-YEAR FLOOD
BOTTOM VELOCITIES
EXISTING CONDITIONS
DISCHARGE 16,000 CFS
POOL EL 205.8
MAX $_M$ TAILWATER EL 192.5

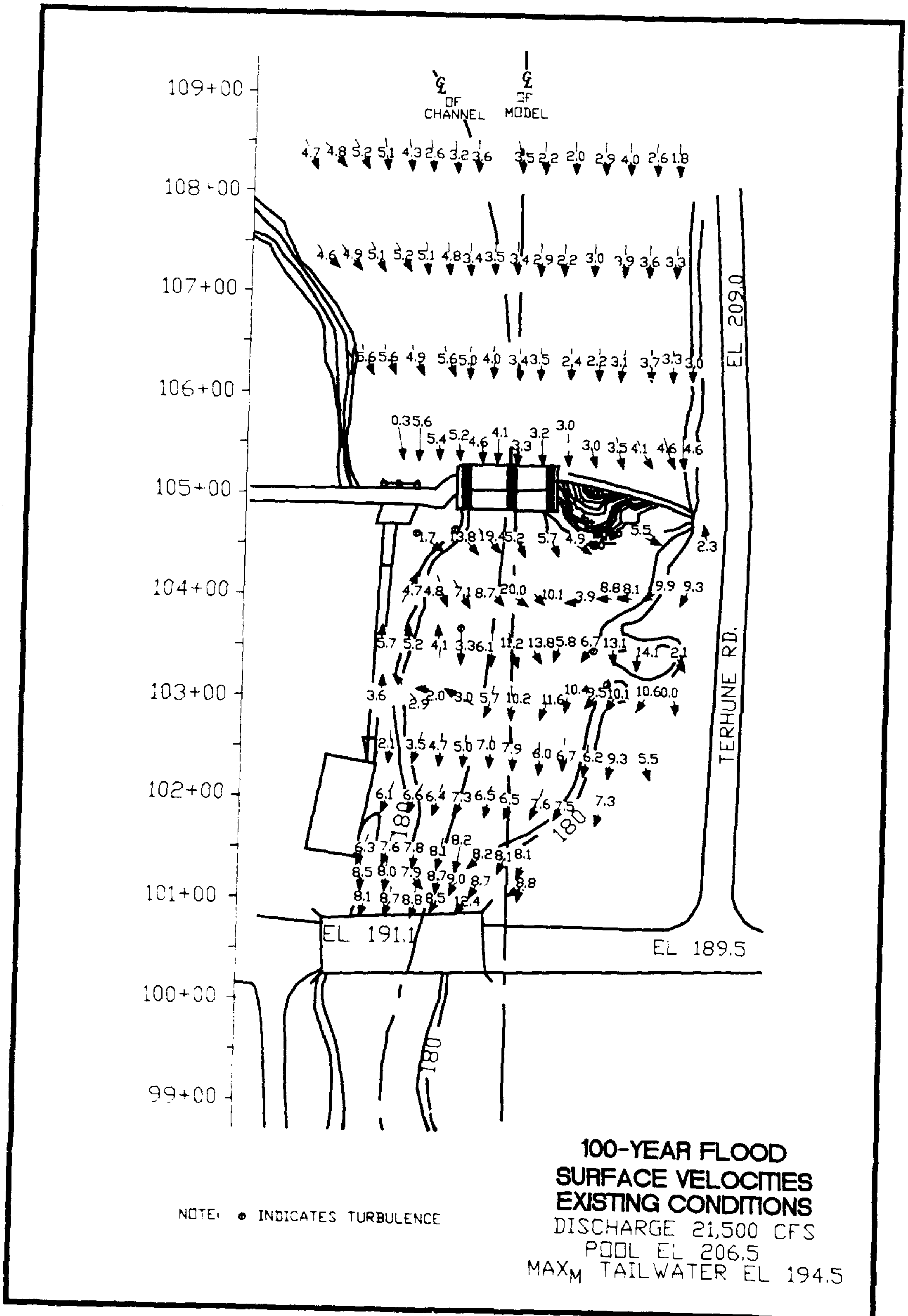
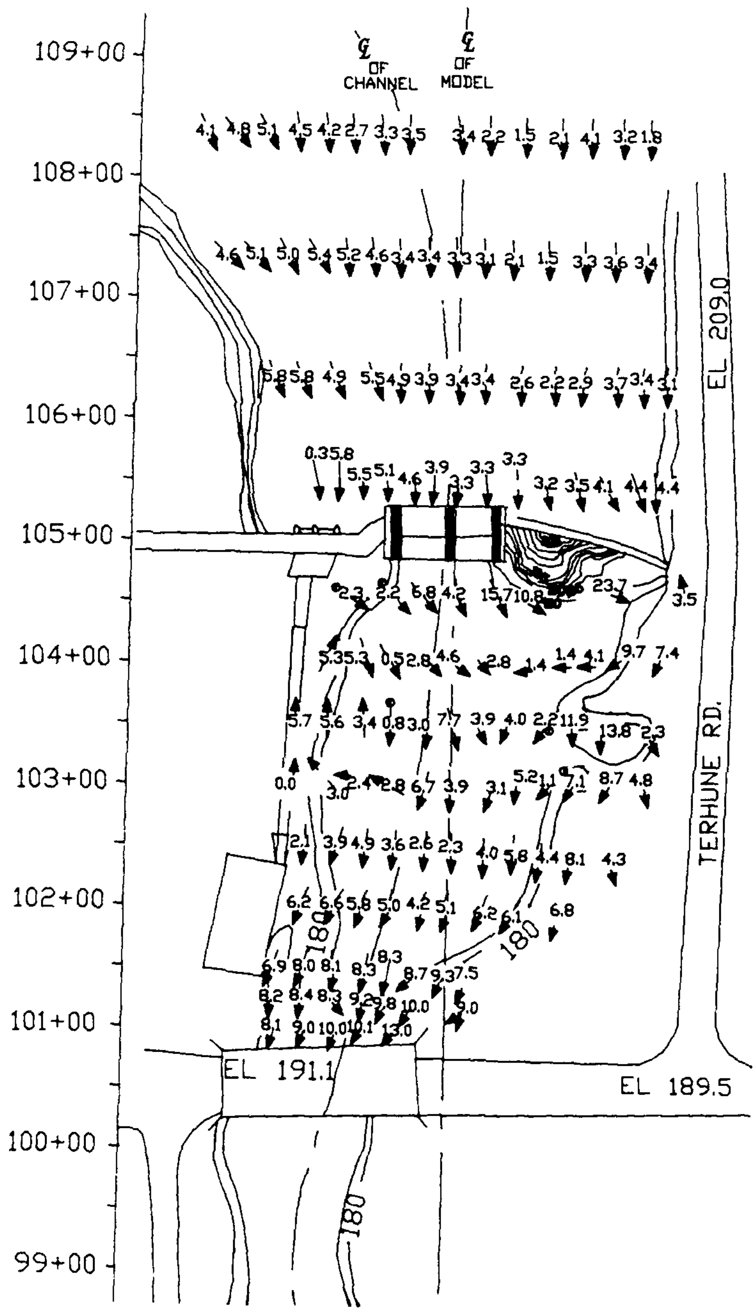


PLATE 30
(Sheet 1 of 3)



NOTE: • INDICATES TURBULENCE

100-YEAR FLOOD
MIDDEPTH VELOCITIES
EXISTING CONDITIONS

DISCHARGE 21,500 CFS
POOL EL 206.5
MAX$_M$ TAILWATER EL 194.5

PLATE 30
(Sheet 2 of 3)

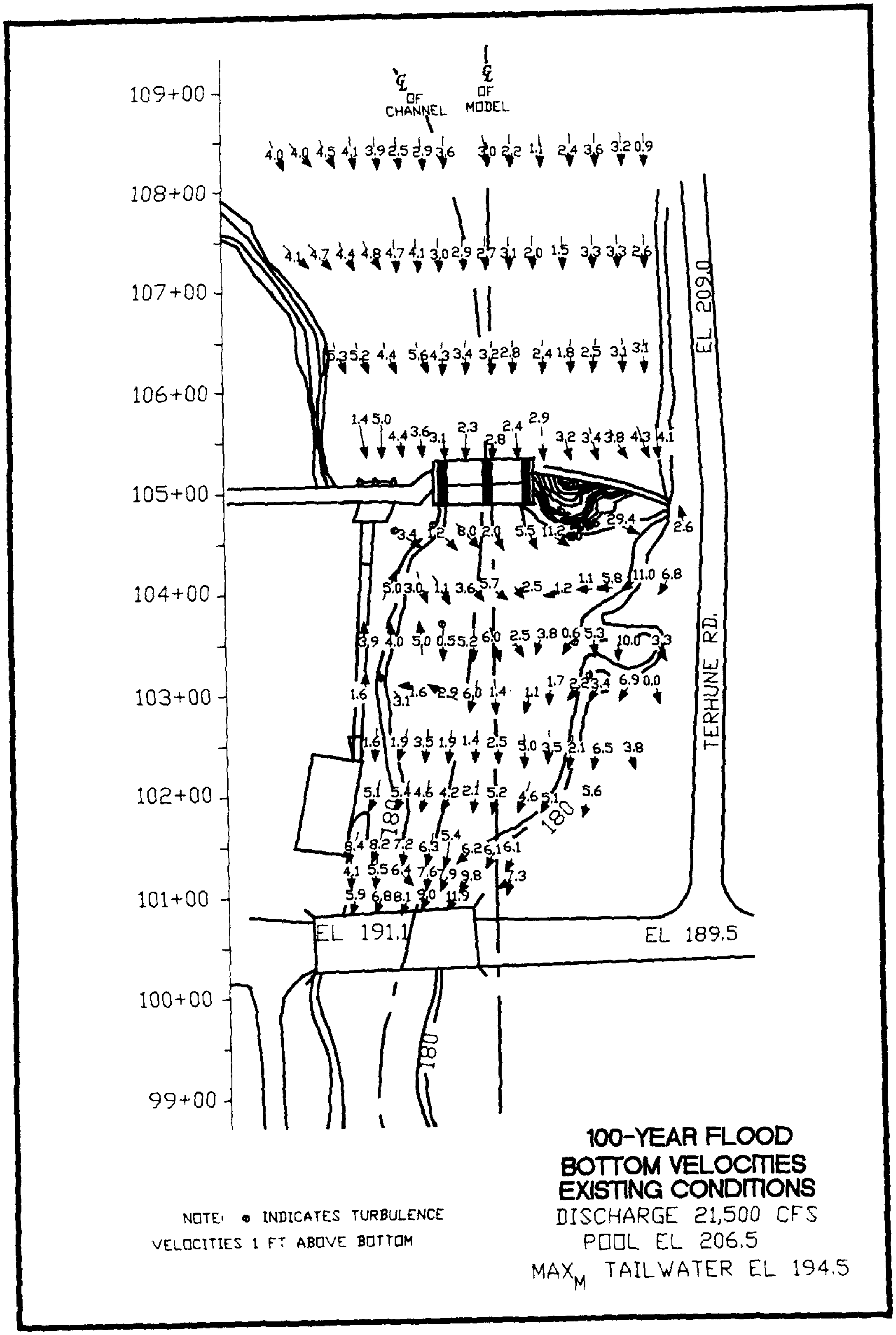
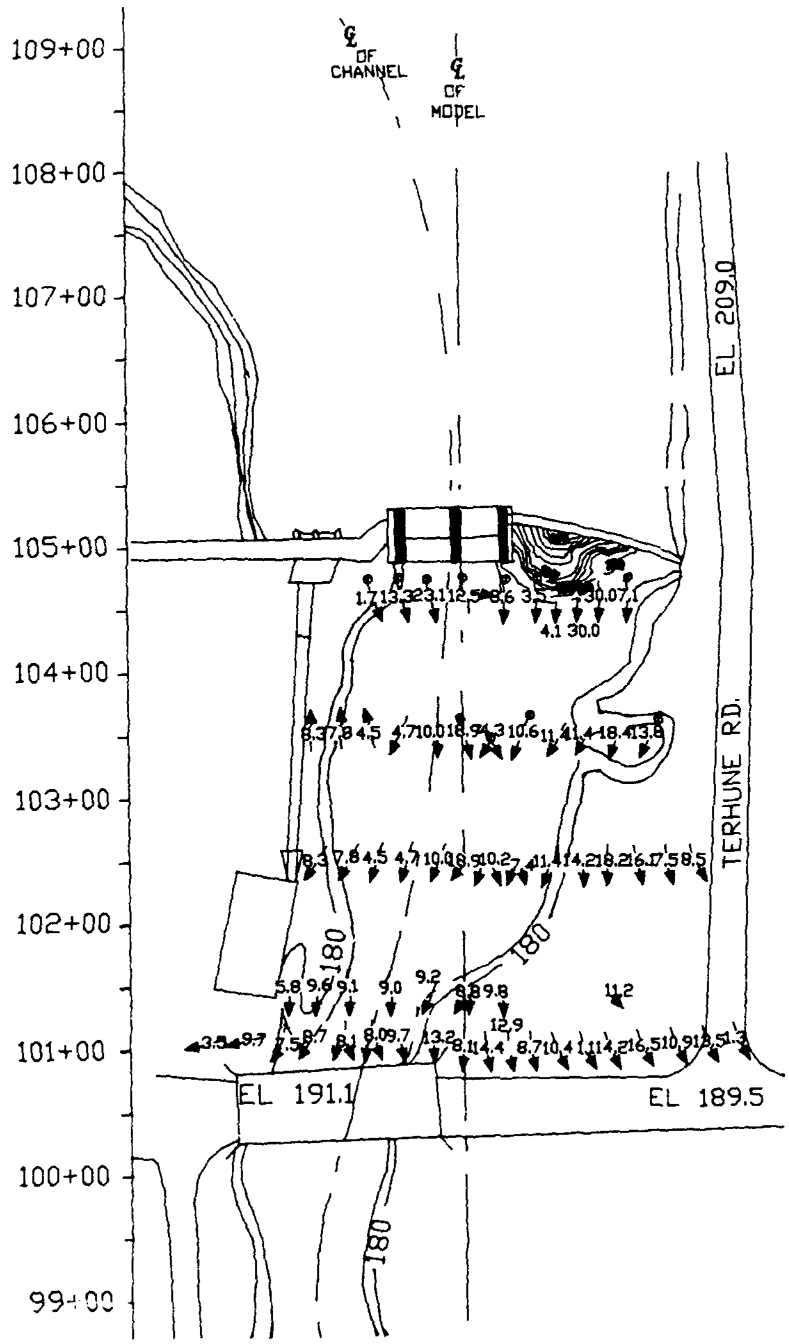


PLATE 30
(Sheet 3 of 3)



NOTE: • INDICATES TURBULENCE

SPF SURFACE VELOCITIES EXISTING CONDITIONS

DISCHARGE 38,500 CFS
POOL EL 209.0
MAX$_M$ TAILWATER EL 199.0

PLATE 31
(Sheet 1 of 3)

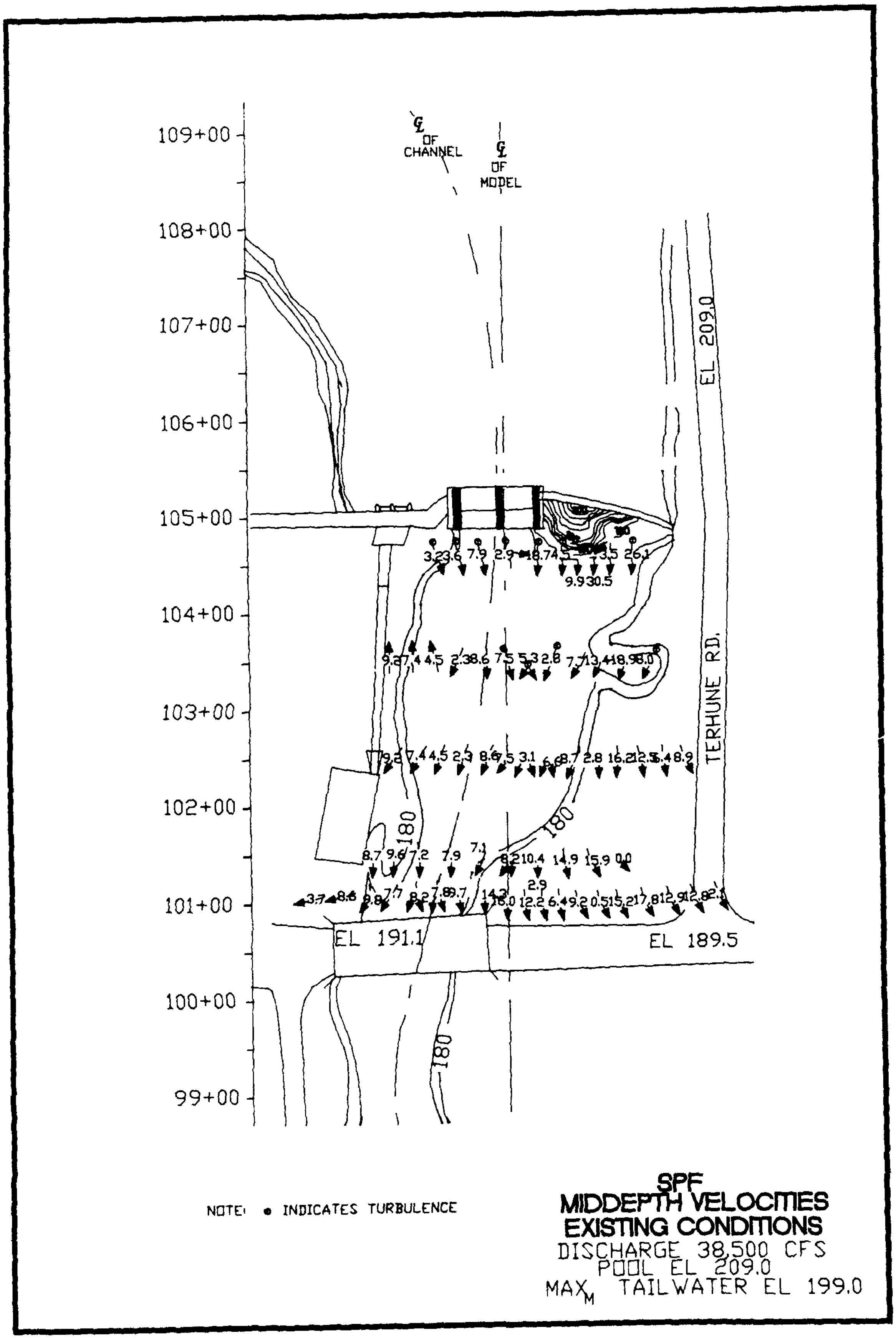


PLATE 31
(Sheet 2 of 3)

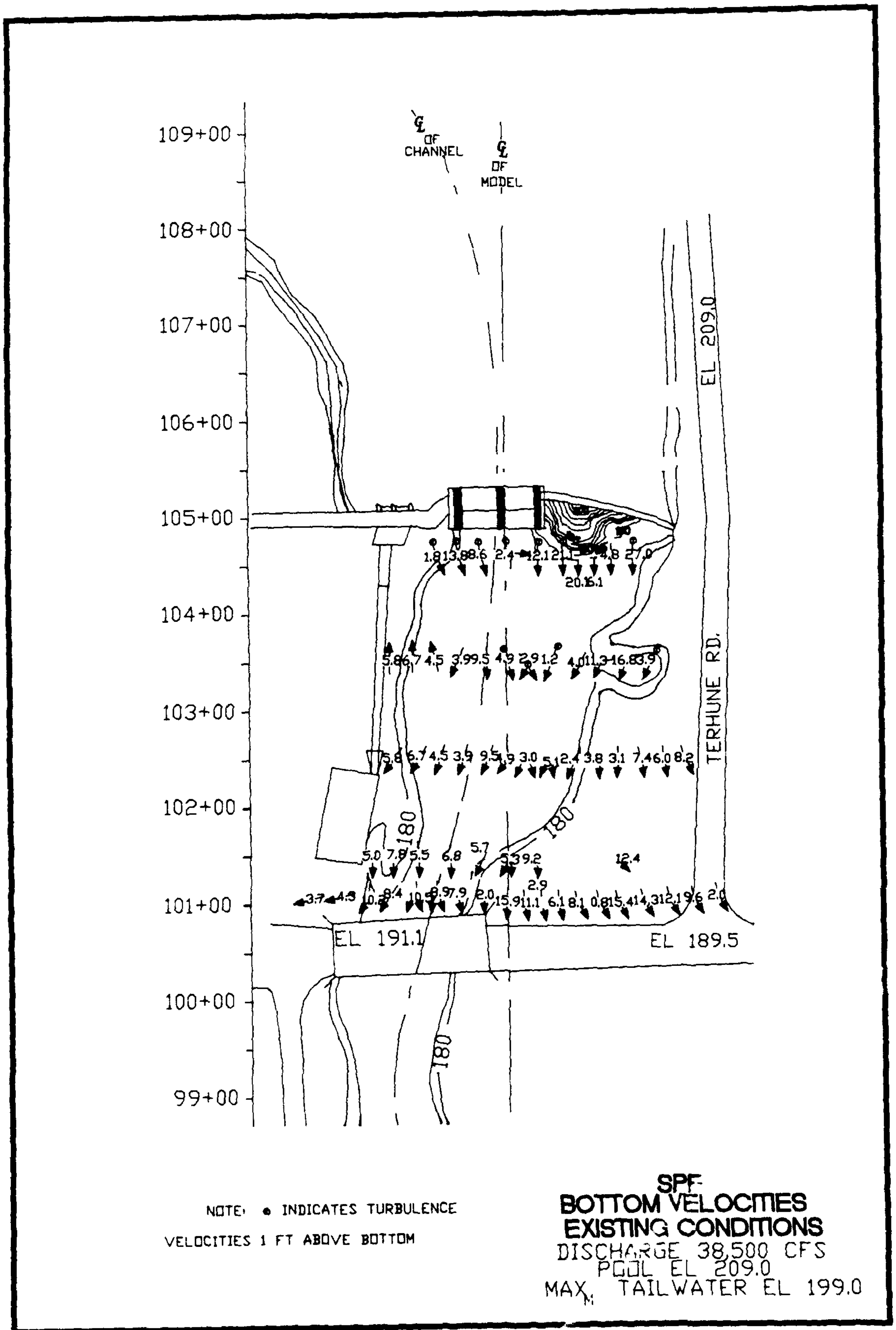
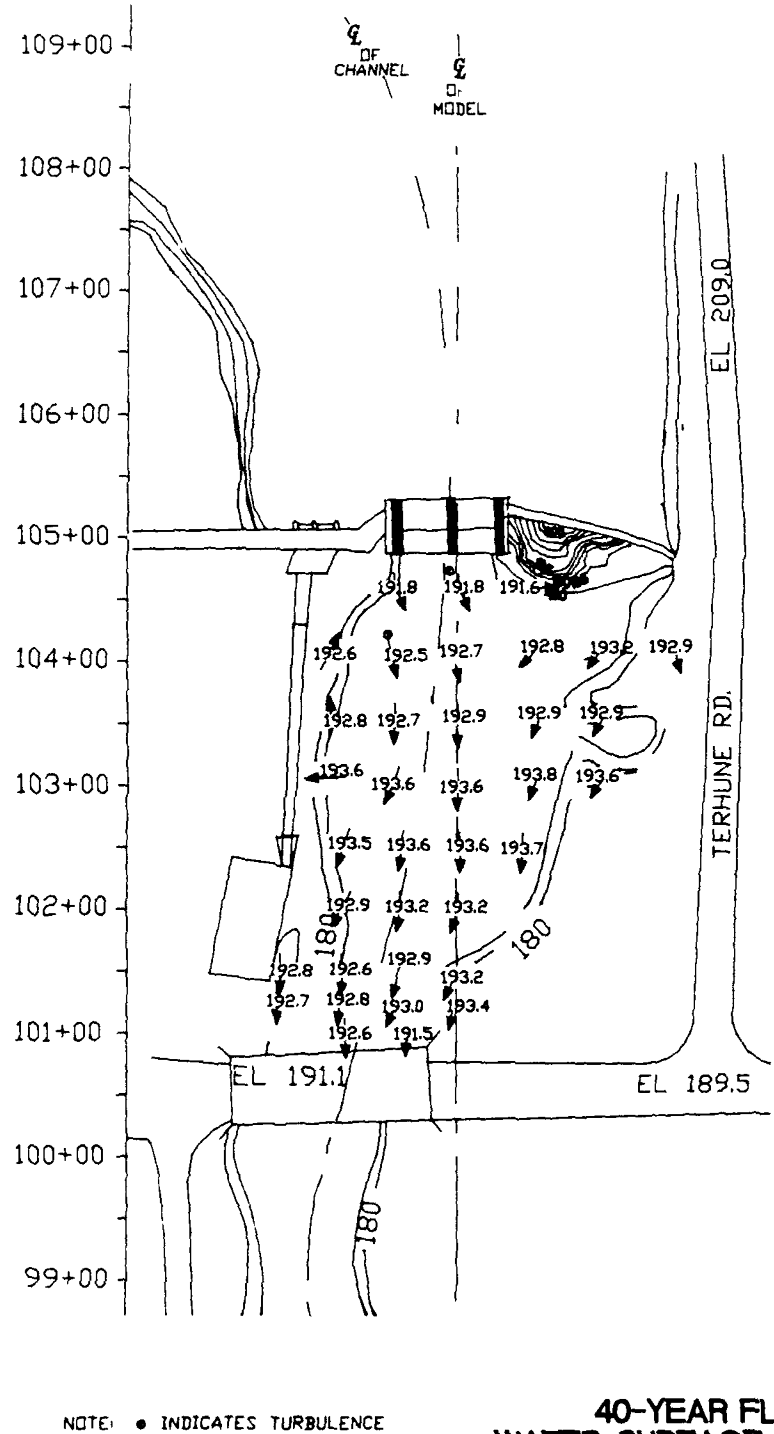
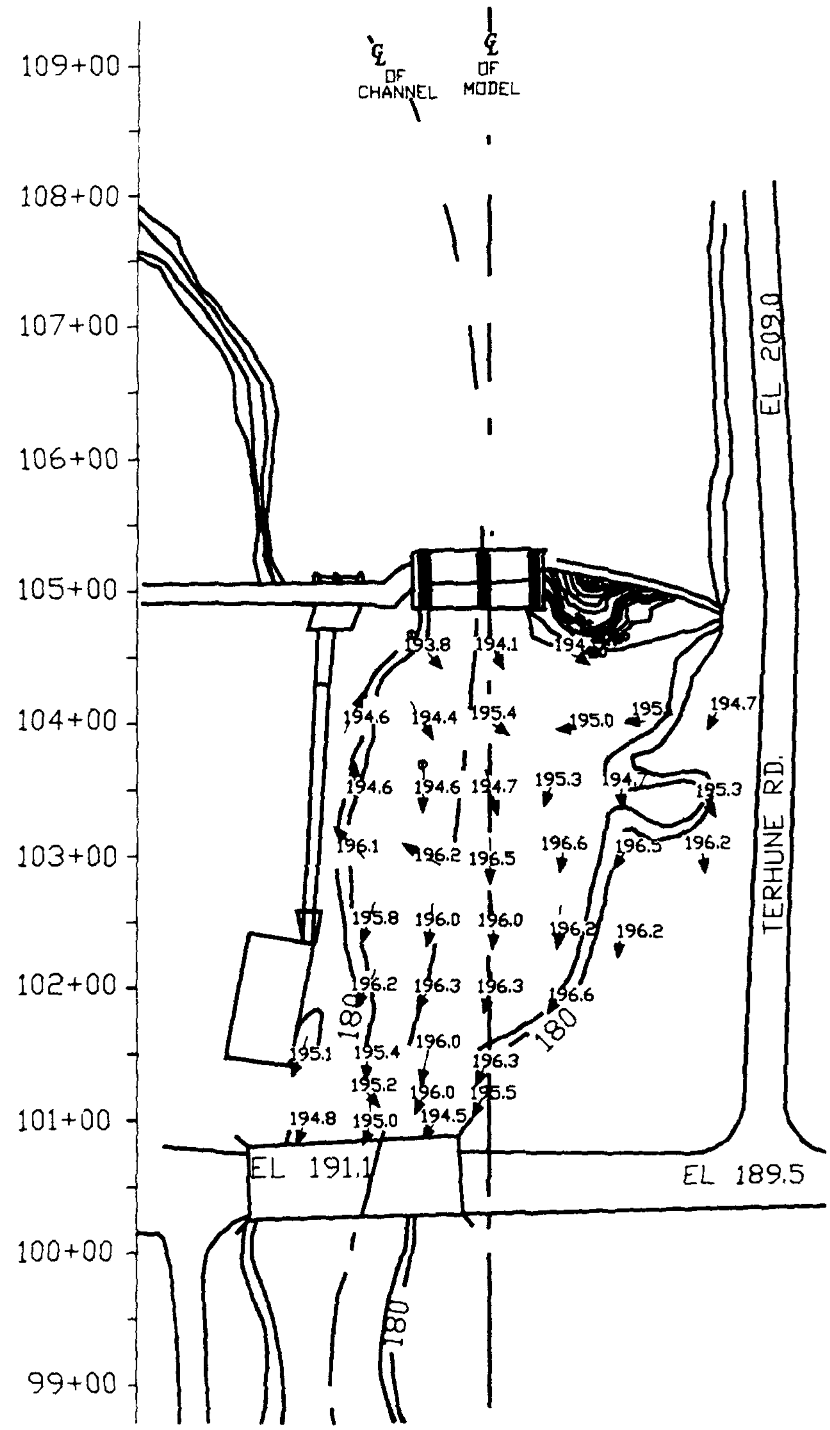


PLATE 31
(Sheet 3 of 3)



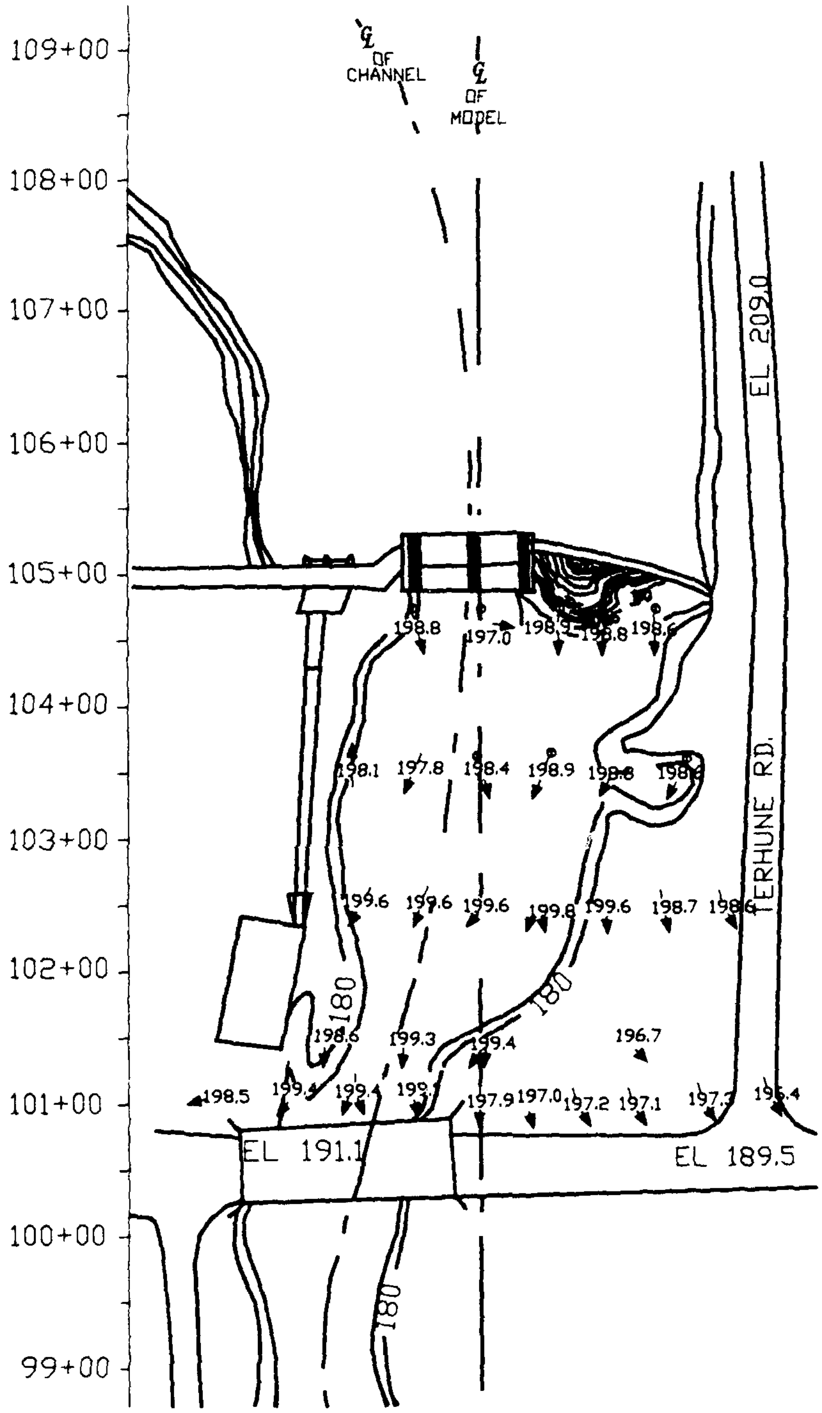
40-YEAR FLOOD
WATER-SURFACE ELEVATIONS
EXISTING CONDITIONS
DISCHARGE 16,000 CFS
MAX_M TAILWATER EL 192.5

PLATE 32



100-YEAR FLOOD
WATER-SURFACE ELEVATIONS
EXISTING CONDITIONS

DISCHARGE 21,500 CFS
MAX$_M$ TAILWATER EL 194.5



SPF
WATER-SURFACE ELEVATIONS
EXISTING CONDITIONS
DISCHARGE 38,500 CFS
MAX_M TAILWATER EL 199.0

PLATE 34

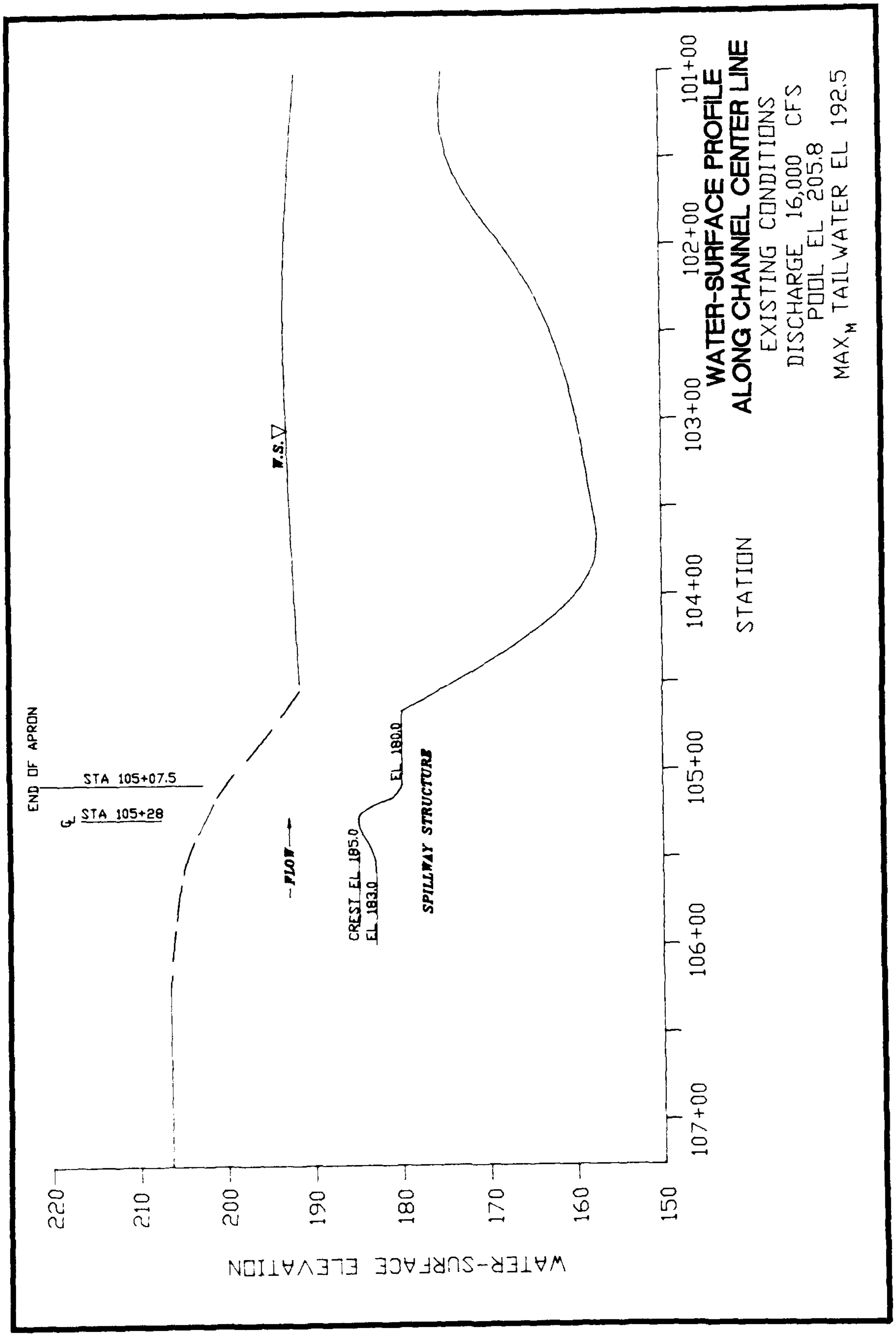


PLATE 35
(Sheet 1 of 3)

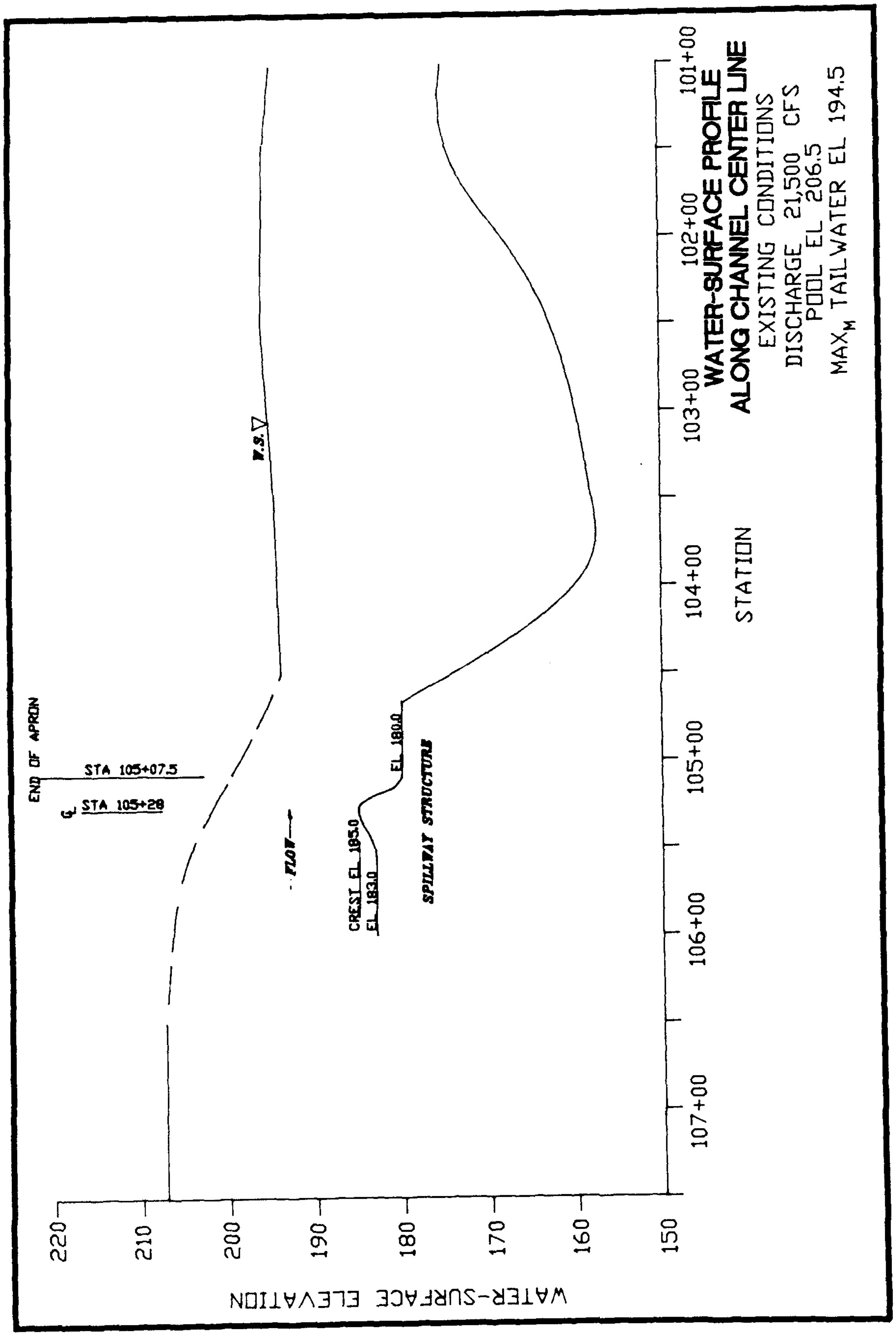
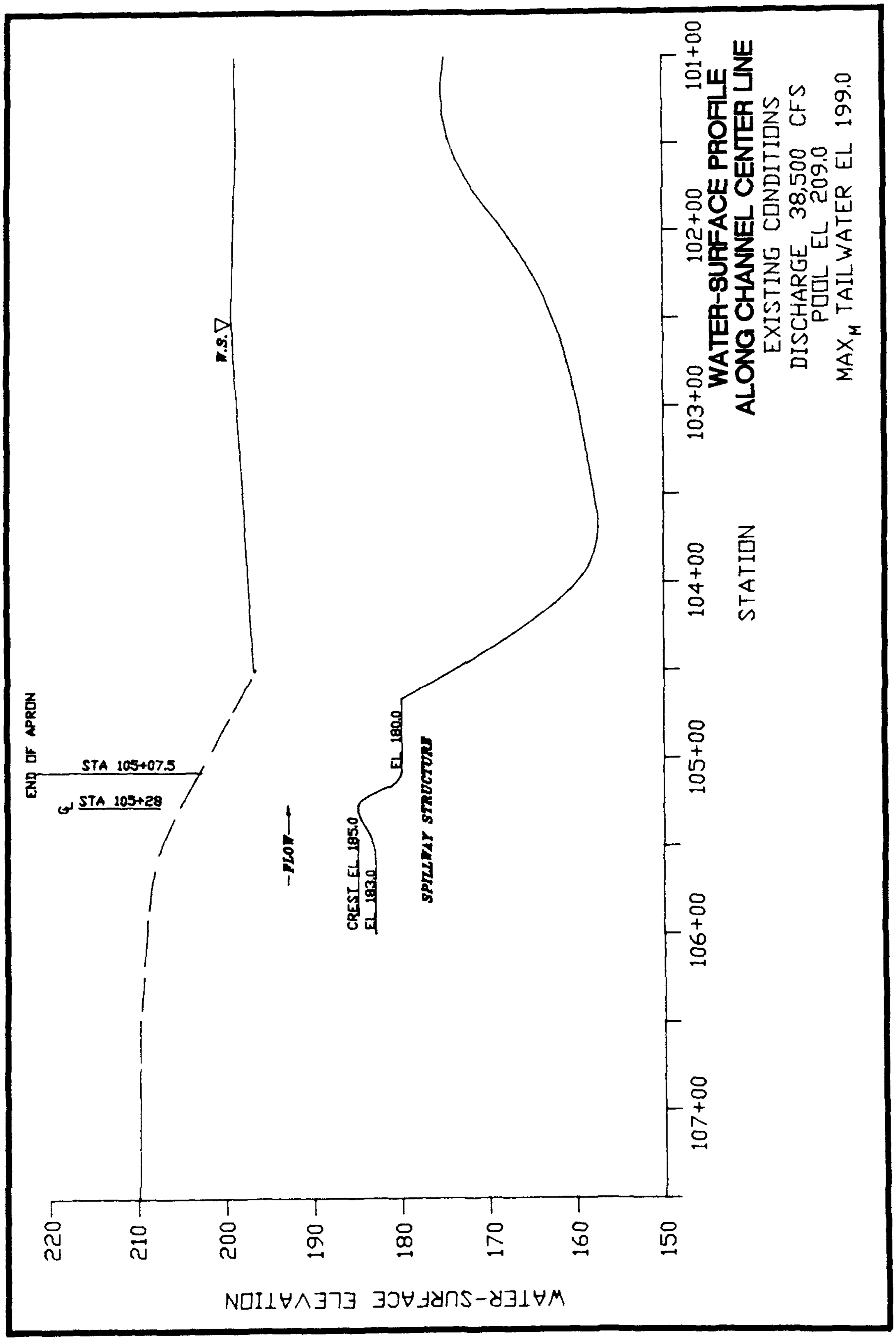
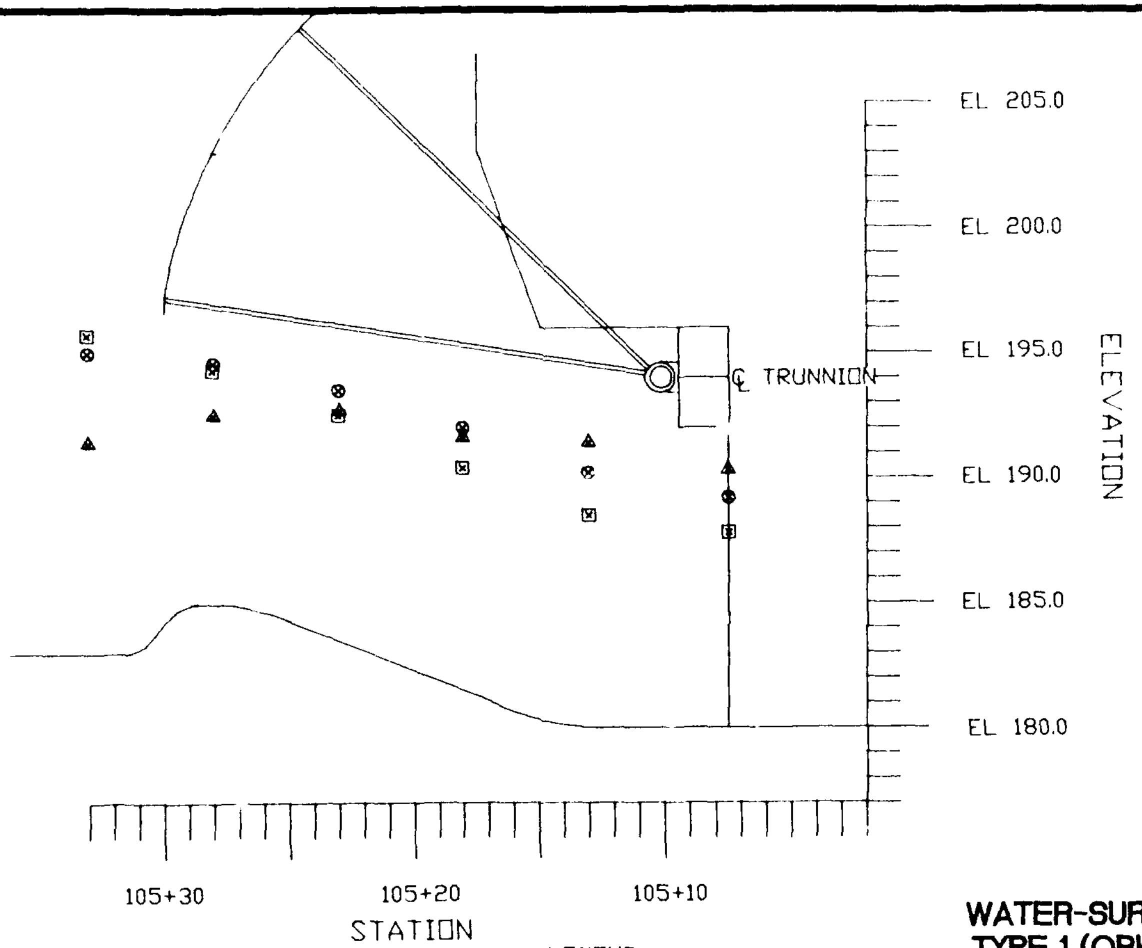


PLATE 35
(Sheet 2 of 3)


WATER-SURFACE PROFILE
ALONG CHANNEL CENTER LINE
EXISTING CONDITIONS
DISCHARGE 38,500 CFS
POOL EL 209.0
MAX$_M$ TAILWATER EL 199.0
WATER-SURFACE ELEVATION
STATION
220
210
200
190
180
170
160
150
101+00
102+00
103+00
104+00
105+00
106+00
107+00
W.S.
END OF APRON
STA 105+07.5
℄ STA 105+28
FLOW
CREST EL 185.0
EL 183.0
EL 180.0
SPILLWAY STRUCTURE

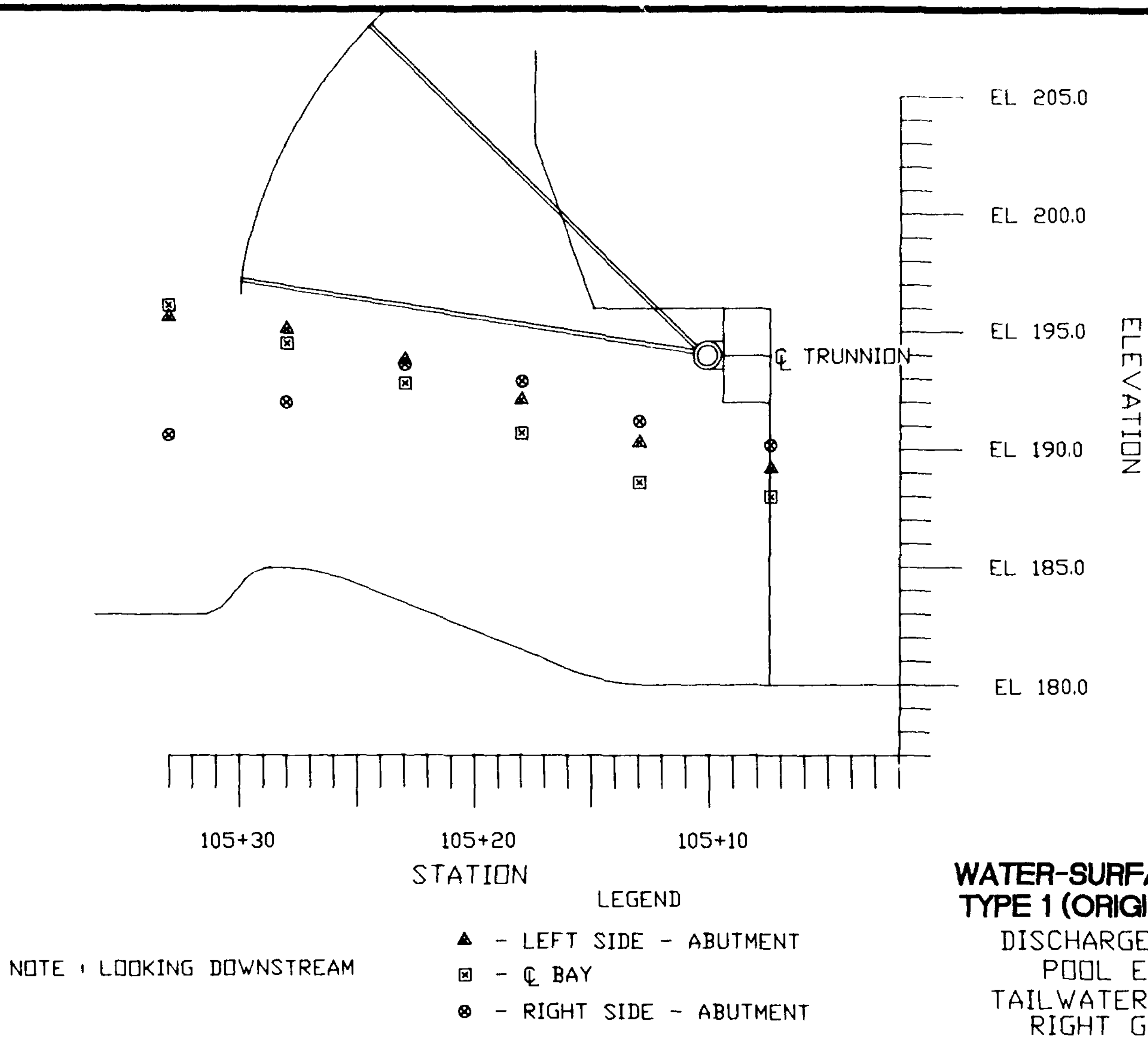


WATER-SURFACE PROFILE
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 16,000 CFS
POOL EL 201.1
TAILWATER EL 192.5
LEFT GATE BAY

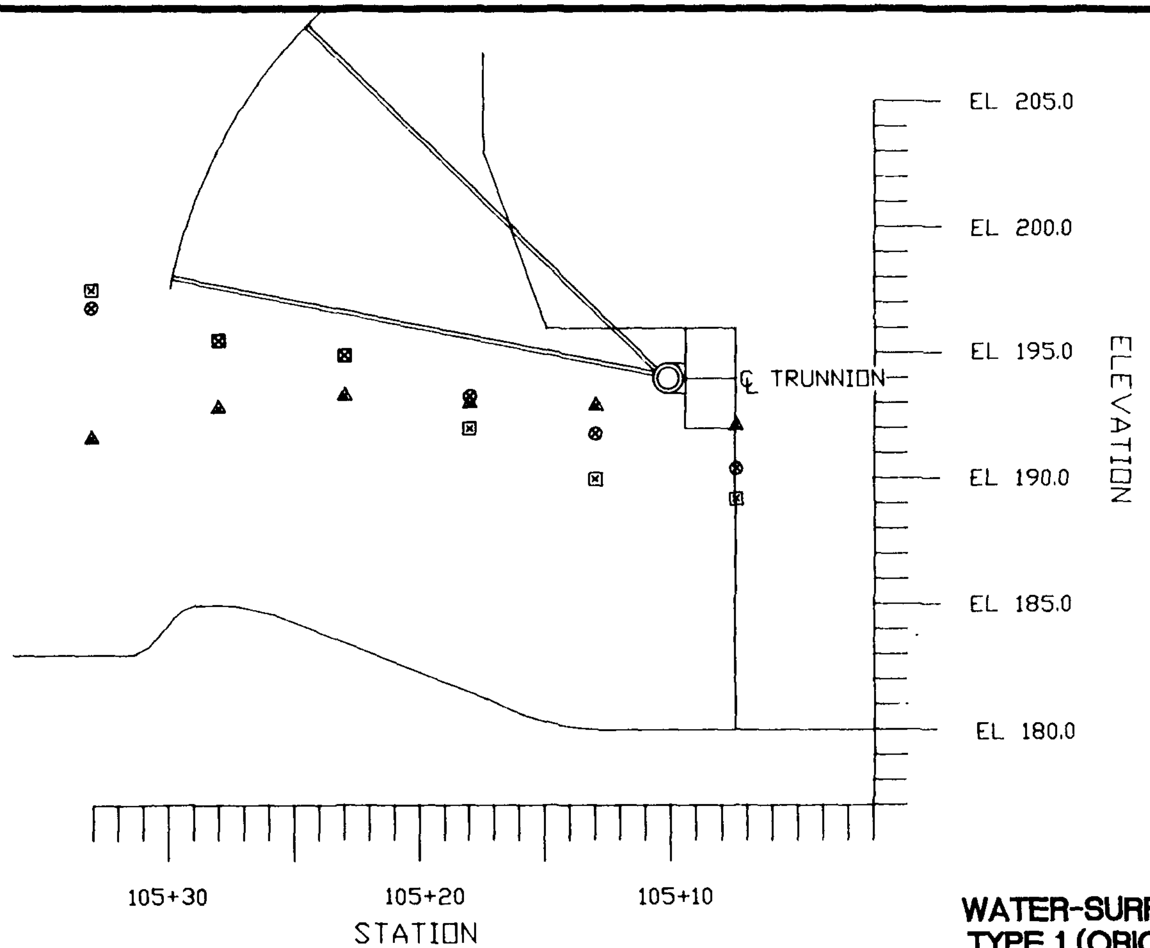
LEGEND

▲ - LEFT SIDE - ABUTMENT
⊠ - ℄ BAY
⊗ - RIG.T SIDE - ABUTMENT

NOTE : LOOKING DOWNSTREAM



WATER-SURFACE PROFILE
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 16,000 CFS
POOL EL 201.1
TAILWATER EL 192.5
RIGHT GATE BAY



LEGEND

▲ - LEFT SIDE - ABUTMENT

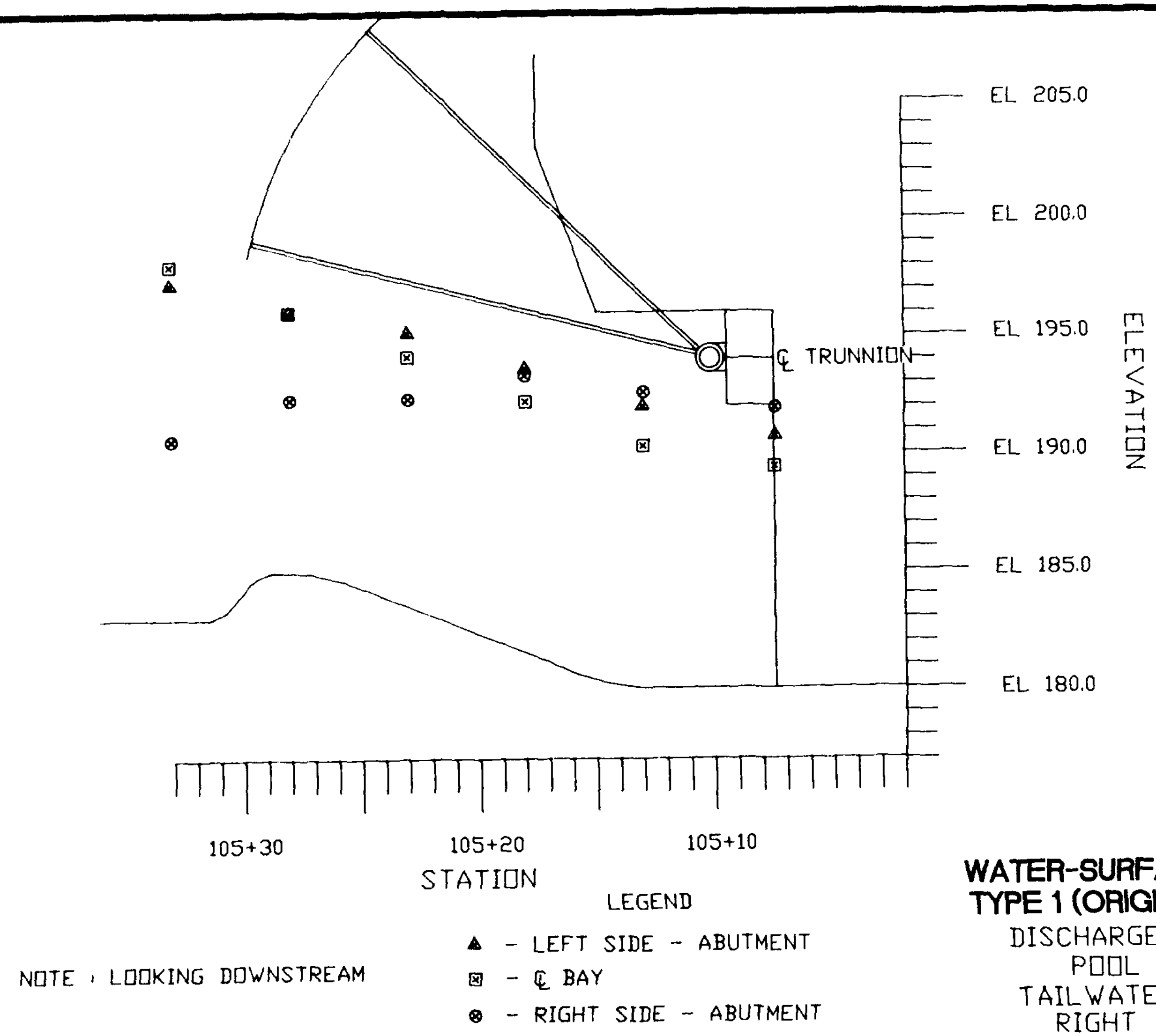
⊠ - ℄ BAY

⊗ - RIGHT SIDE - ABUTMENT

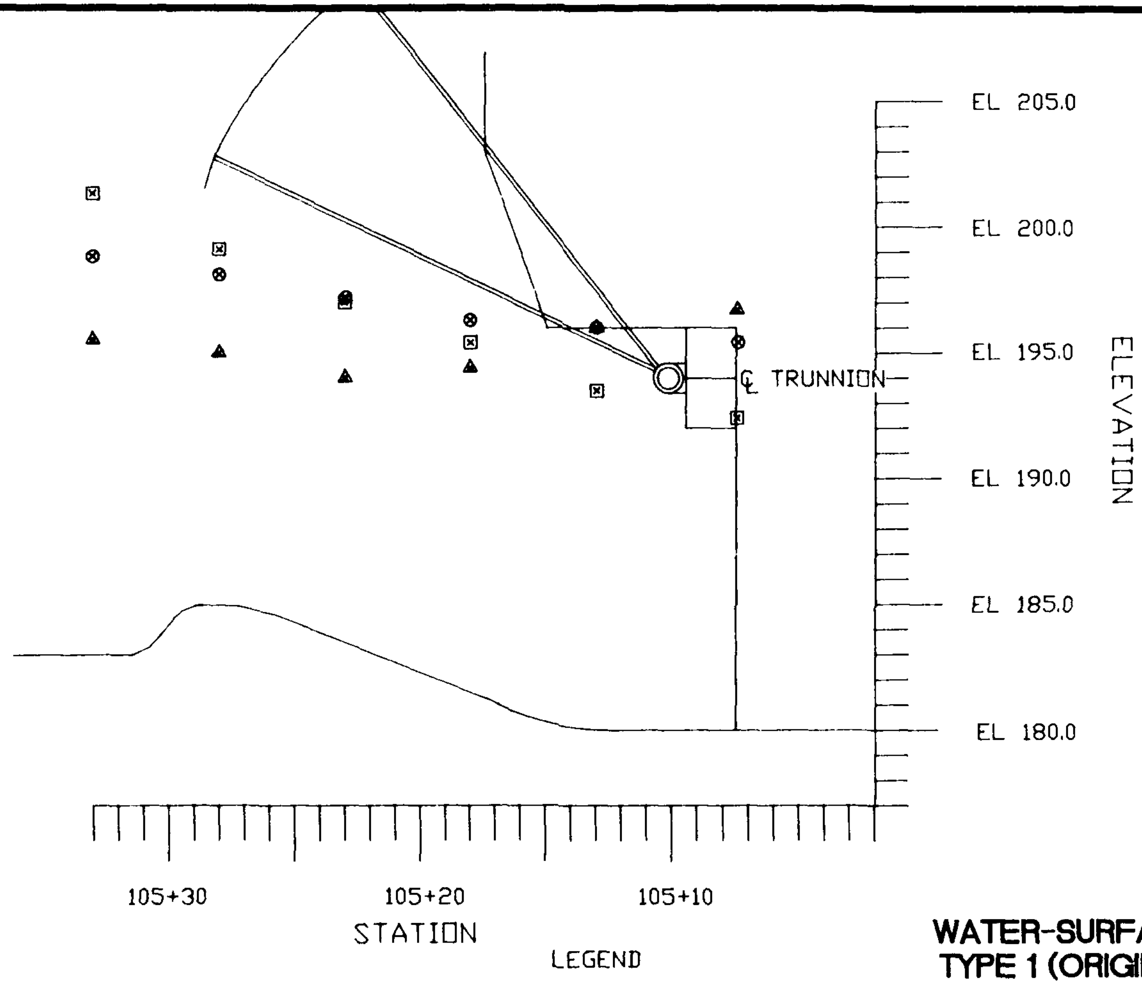
NOTE : LOOKING DOWNSTREAM

WATER-SURFACE PROFILE
TYPE 1 (ORIGINAL) DESIGN

DISCHARGE 21,500 CFS
POOL EL 202.5
TAILWATER EL 194.5
LEFT GATE BAY



WATER-SURFACE PROFILE
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 21,500 CFS
POOL EL202.5
TAILWATER EL 194.5
RIGHT GATE BAY



LEGEND

▲ - LEFT SIDE - ABUTMENT
⊠ - ℄ BAY
⊗ - RIGHT SIDE - ABUTMENT

NOTE : LOOKING DOWNSTREAM

WATER-SURFACE PROFILE
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 38,500 CFS
POOL EL 206.5
TAILWATER EL 199.0
LEFT GATE BAY

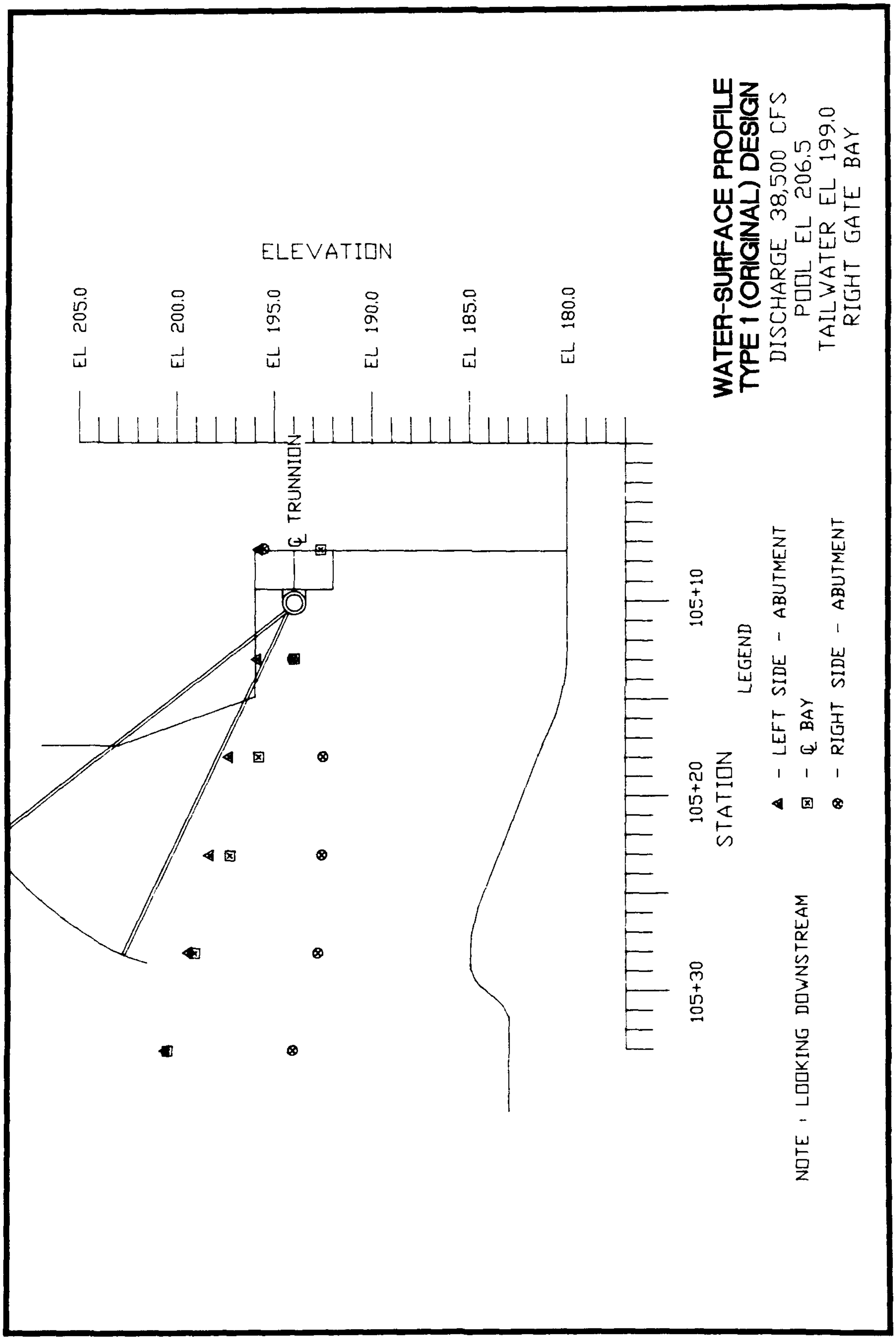
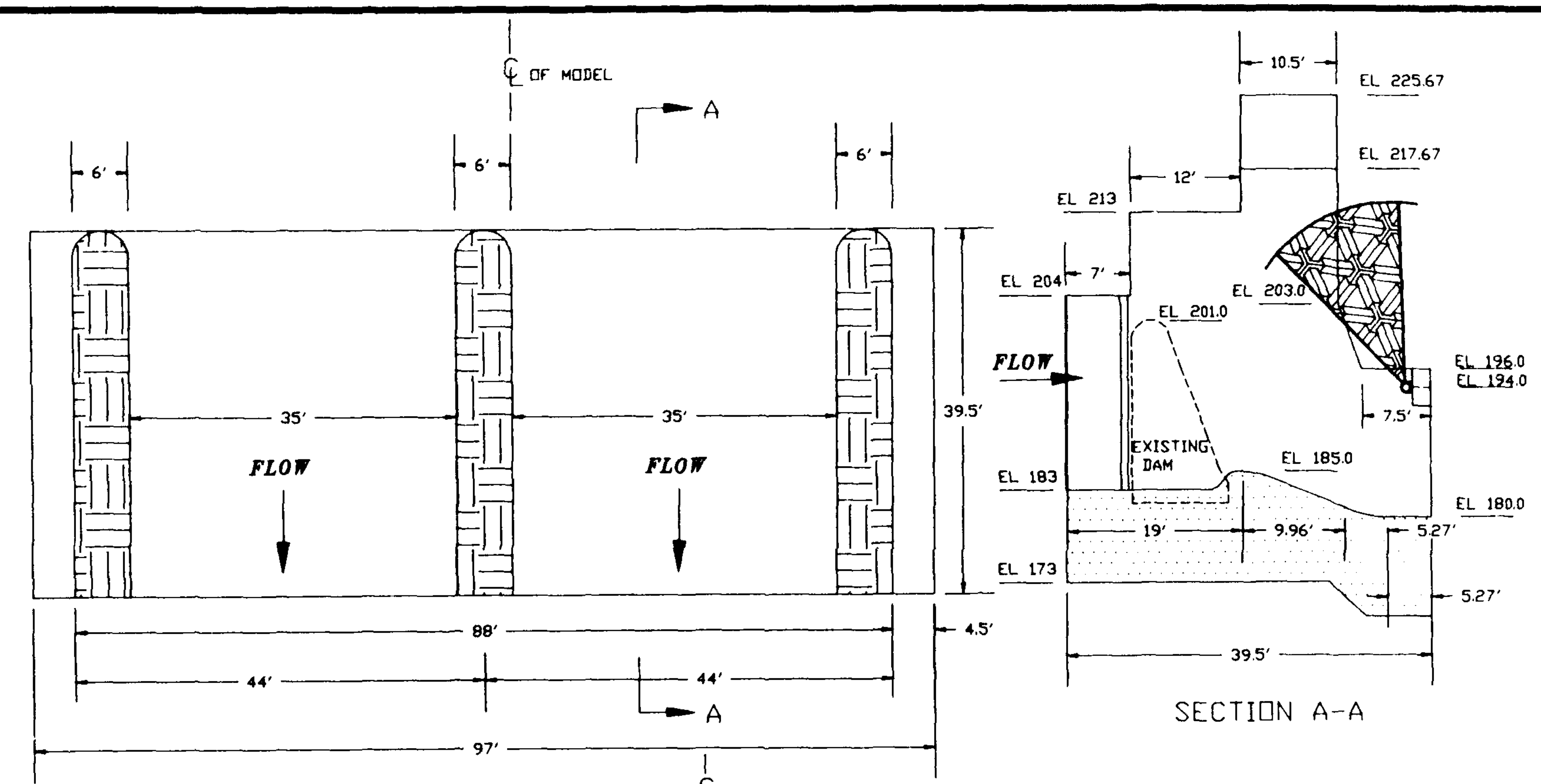


PLATE 38
(Sheet 2 of 2)



VELOCITIES

SURFACE	7.2	2.3	10.5	21.7	21.8	4.9	2.0
MID DEPTH	8.6	1.6	8.3	19.6	18.3	2.2	2.7
BOTTOM	6.9	2.1	11.0	16.1	15.0	3.0	2.0

℄ OF MODEL

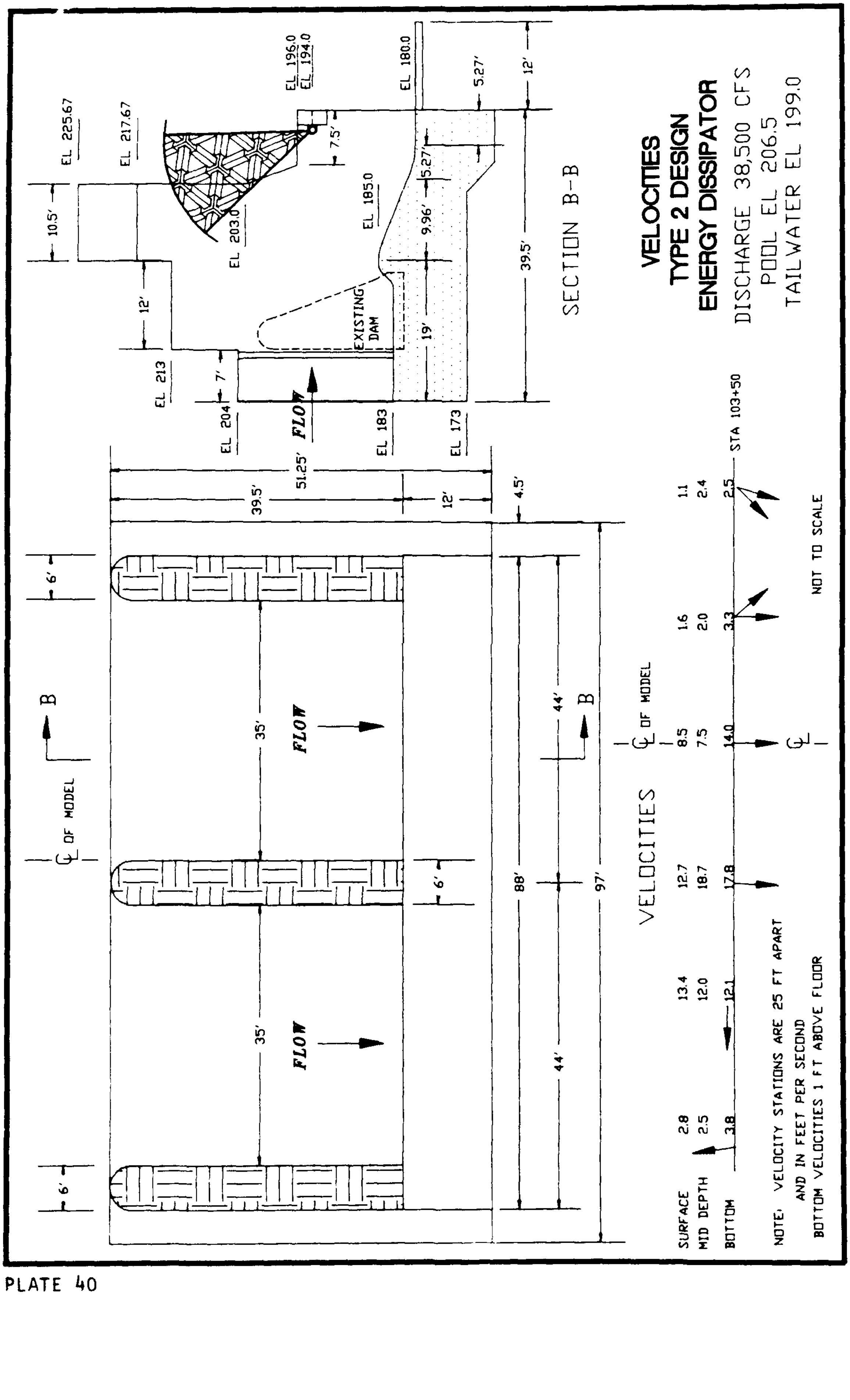
STA 103+50

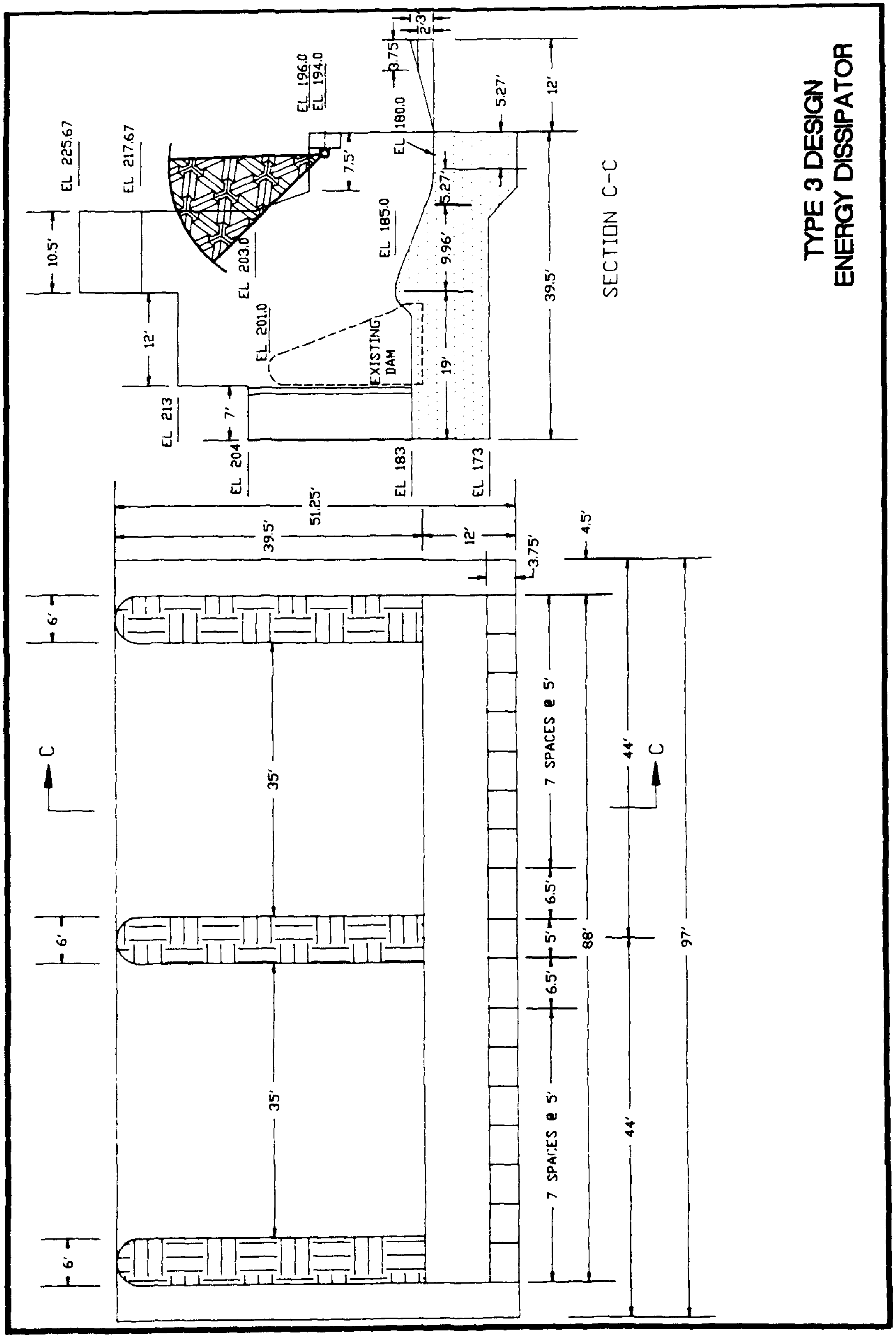
NOTE: VELOCITY STATIONS ARE 25 FT APART AND IN FEET PER SECOND
BOTTOM VELOCITIES 1 FT ABOVE FLOOR

NOT TO SCALE

VELOCITIES
TYPE 1 (ORIGINAL) DESIGN
ENERGY DISSIPATOR

DISCHARGE 38,500 CFS
POOL EL 206.5
TAILWATER EL 199.0


VELOCITIES
TYPE 2 DESIGN
ENERGY DISSIPATOR
DISCHARGE 38,500 CFS
POOL EL 206.5
TAILWATER EL 199.0
SECTION B-B
EL 225.67
EL 217.67
EL 213
EL 204
EL 203.0
EL 196.0
EL 194.0
EL 185.0
EL 183
EL 180.0
EL 173
EXISTING DAM
FLOW
STA 103+50
℄ OF MODEL
VELOCITIES
SURFACE 2.8 13.4 12.7 8.5 1.6 1.1
MID DEPTH 2.5 12.0 18.7 7.5 2.0 2.4
BOTTOM 3.8 12.1 17.8 14.0 3.3 2.5
NOT TO SCALE
NOTE: VELOCITY STATIONS ARE 25 FT APART
AND IN FEET PER SECOND
BOTTOM VELOCITIES 1 FT ABOVE FLOOR



TYPE 3 DESIGN ENERGY DISSIPATOR

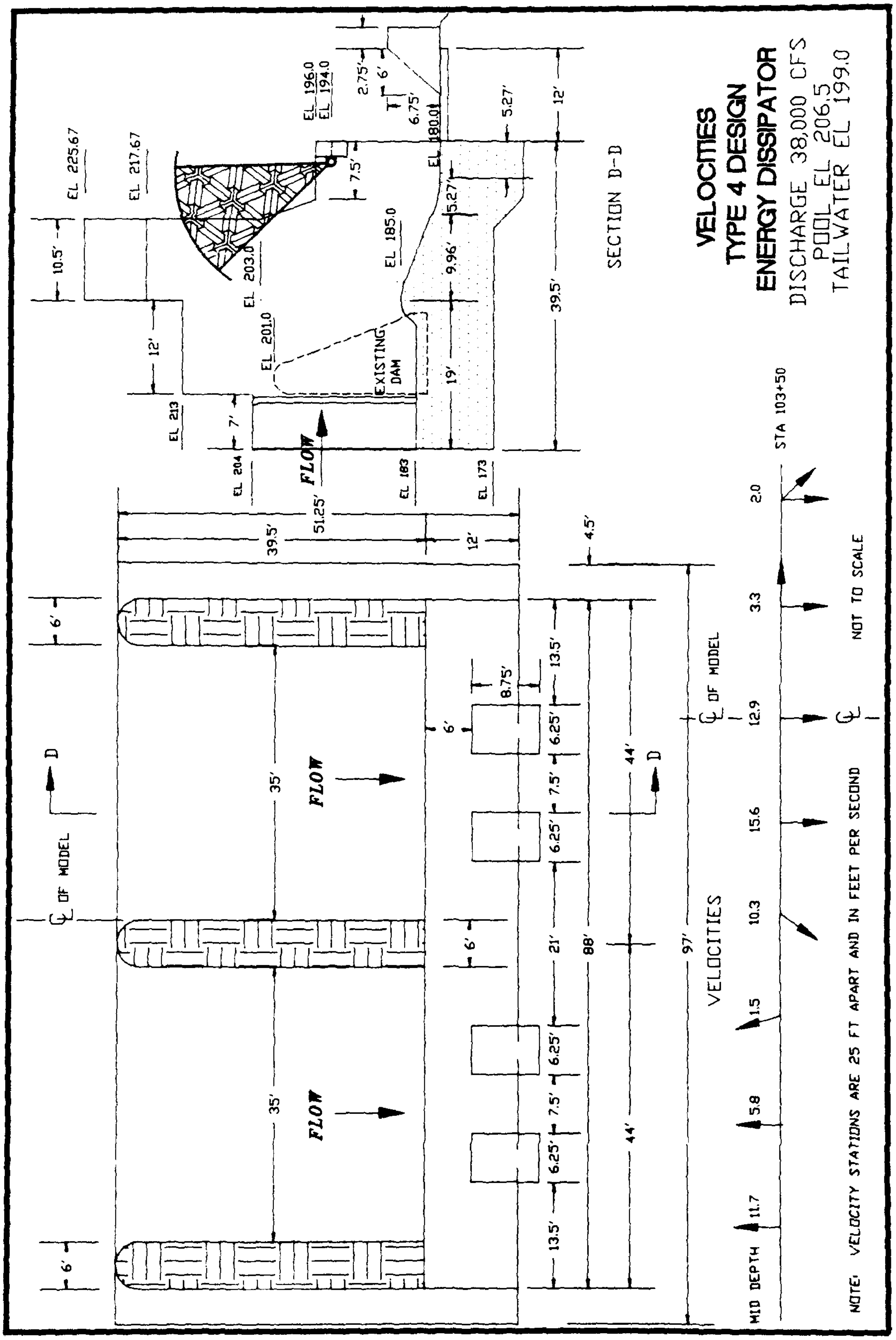
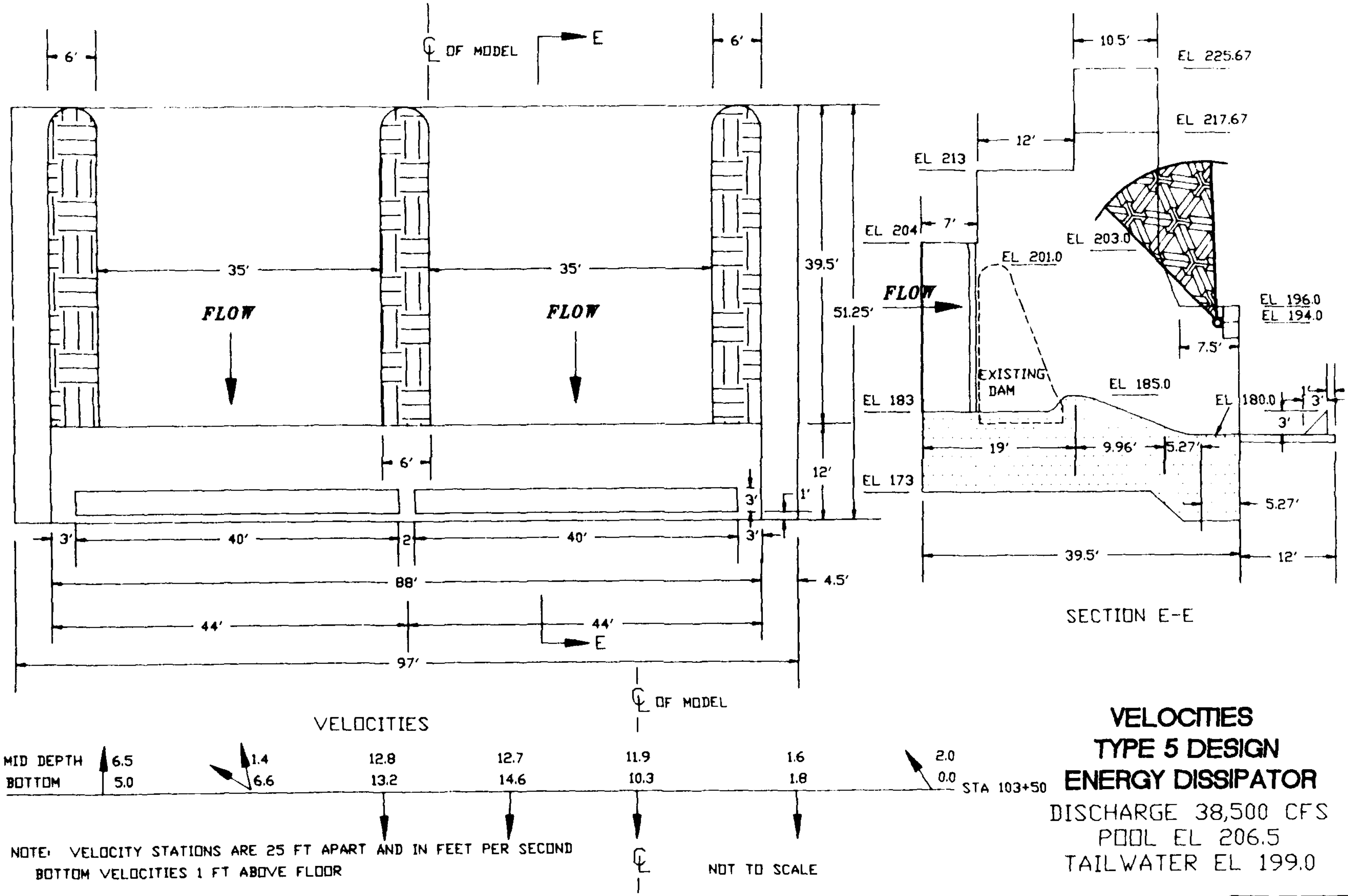
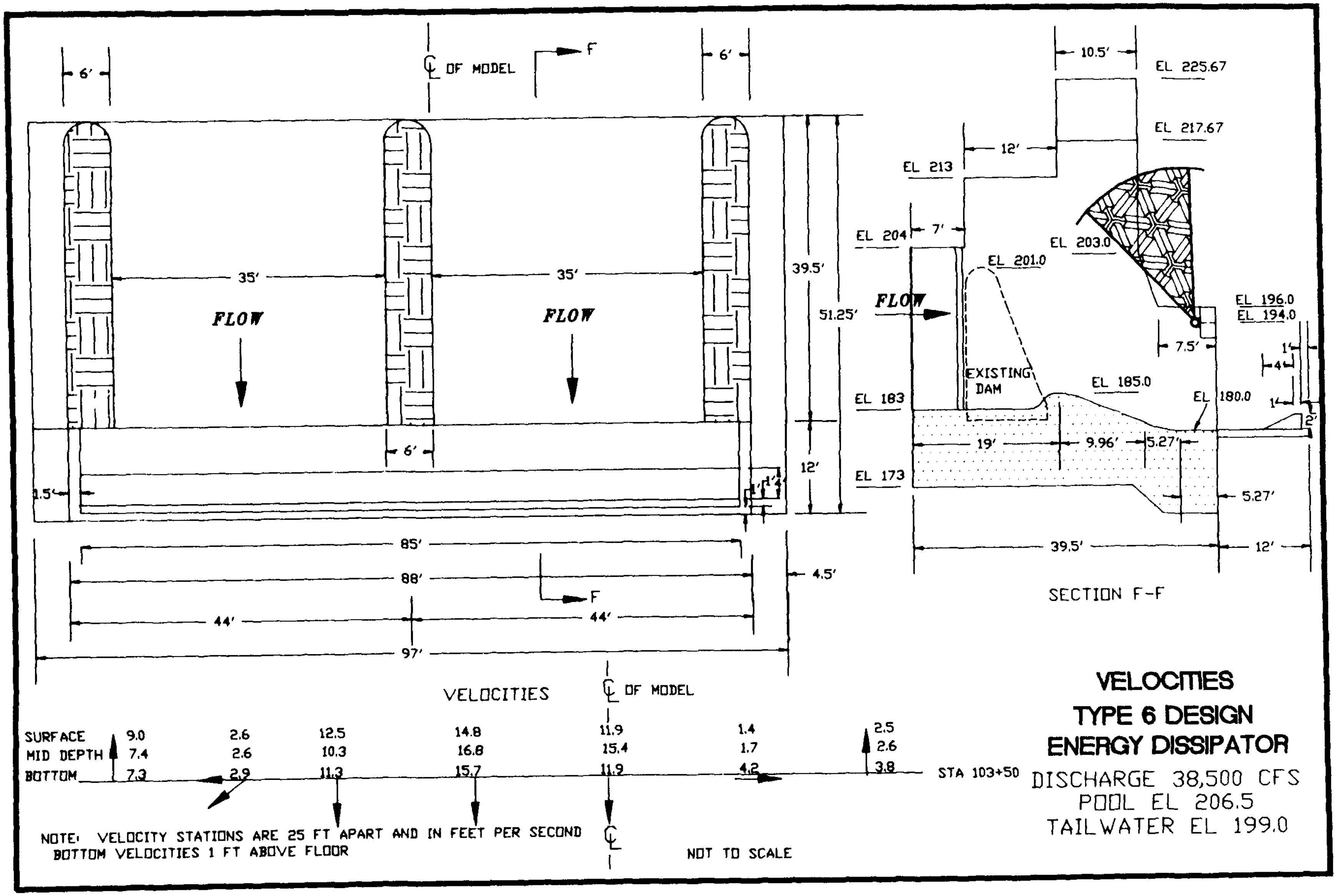
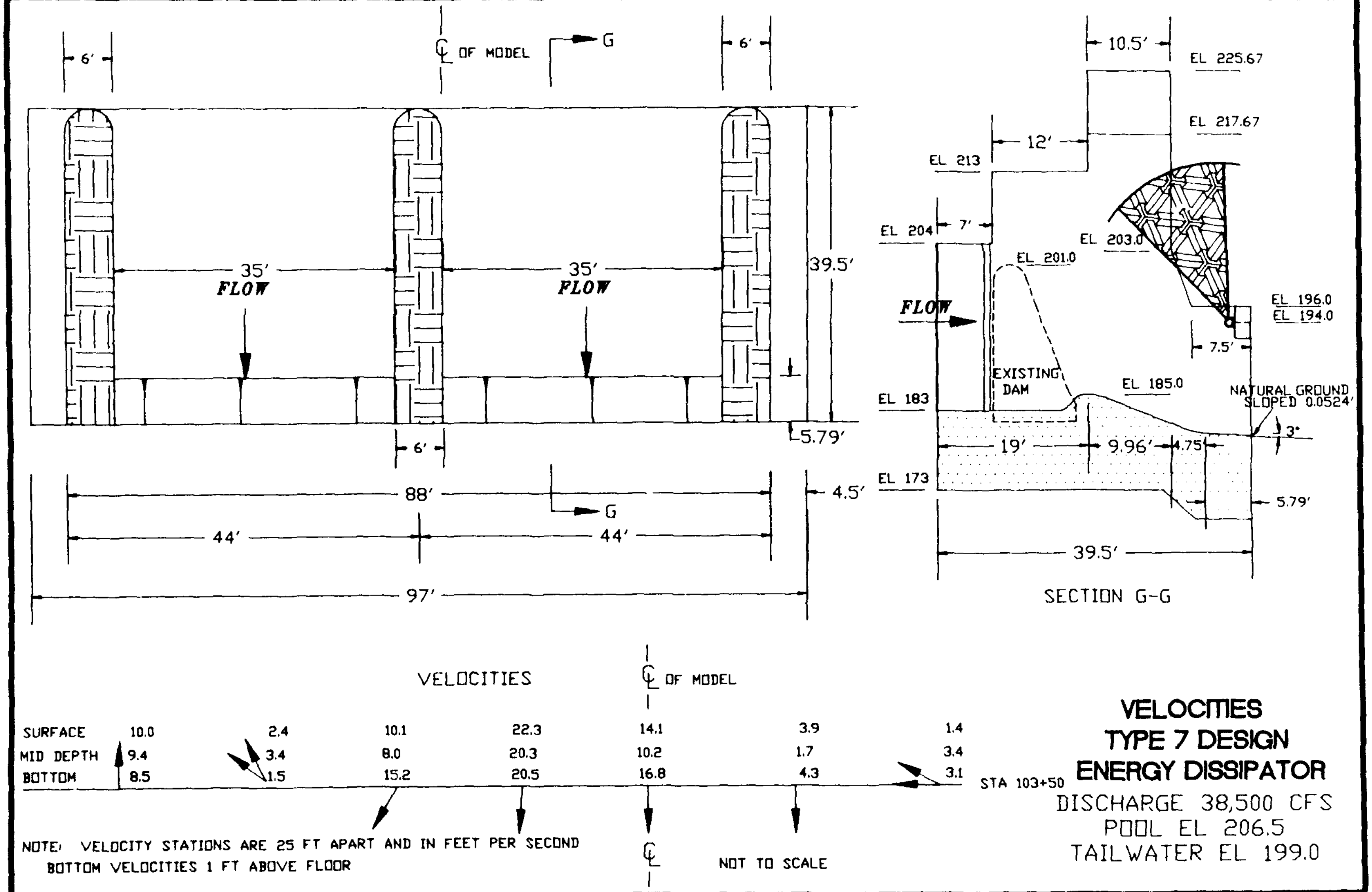

VELOCITIES
TYPE 4 DESIGN
ENERGY DISSIPATOR
DISCHARGE 38,000 CFS
POOL EL 206.5
TAILWATER EL 199.0
SECTION D-D
EL 225.67
EL 217.67
EL 203.0
EL 201.0
EL 196.0
EL 194.0
EL 185.0
EL 180.0
EL 213
EL 204
EL 183
EL 173
EXISTING DAM
FLOW
10.5'
12'
7'
19'
9.96'
5.27'
7.5'
2.75'
6'
6.75'
39.5'
51.25'
4.5'
STA 103+50
℄ OF MODEL
35'
8.75'
13.5'
6.25'
21'
88'
44'
97'
VELOCITIES
MID DEPTH
11.7
5.8
1.5
10.3
15.6
12.9
3.3
2.0
NOT TO SCALE
NOTE: VELOCITY STATIONS ARE 25 FT APART AND IN FEET PER SECOND

PLATE 42

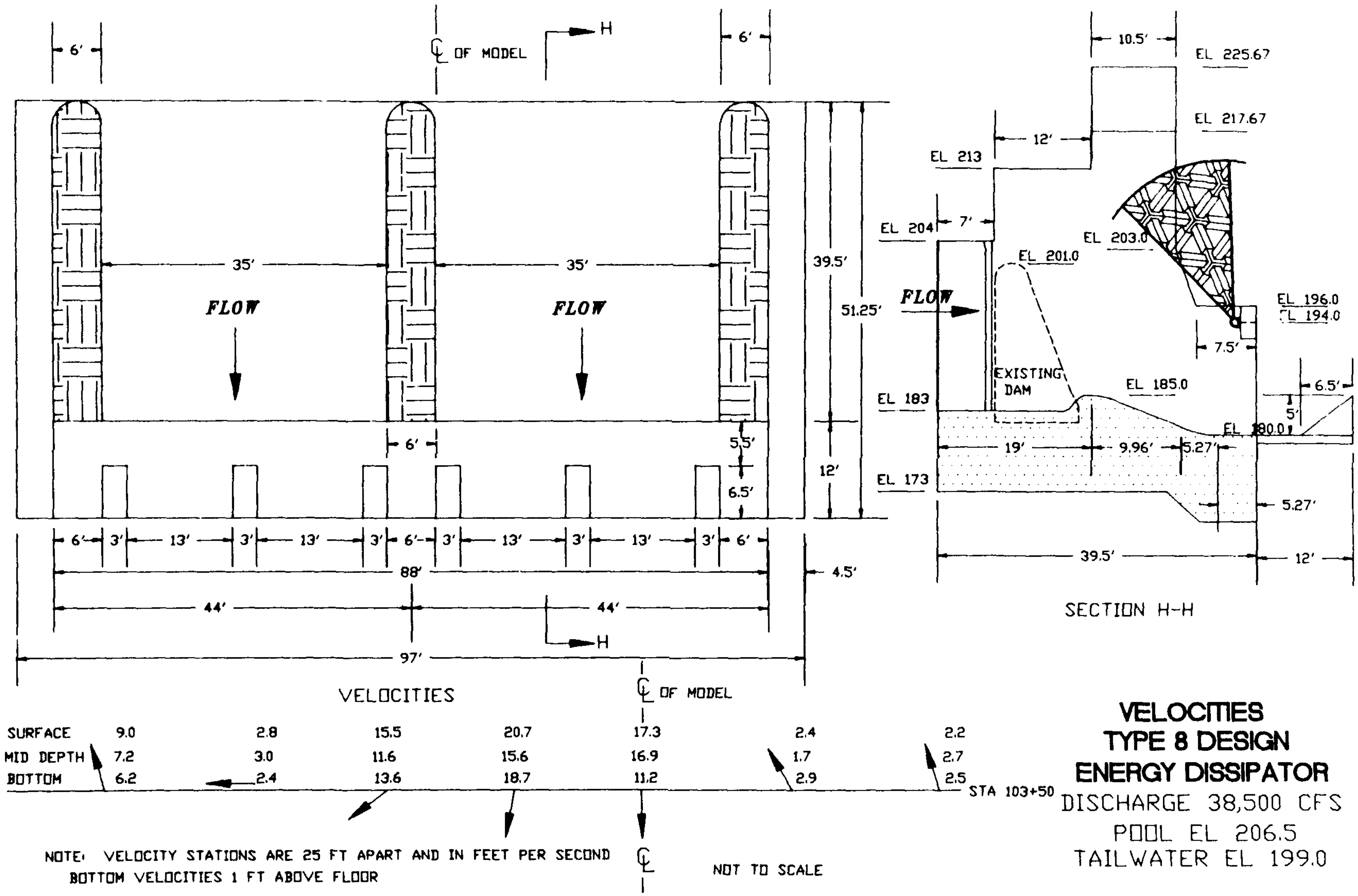


VELOCITIES
TYPE 5 DESIGN
ENERGY DISSIPATOR
DISCHARGE 38,500 CFS
POOL EL 206.5
TAILWATER EL 199.0

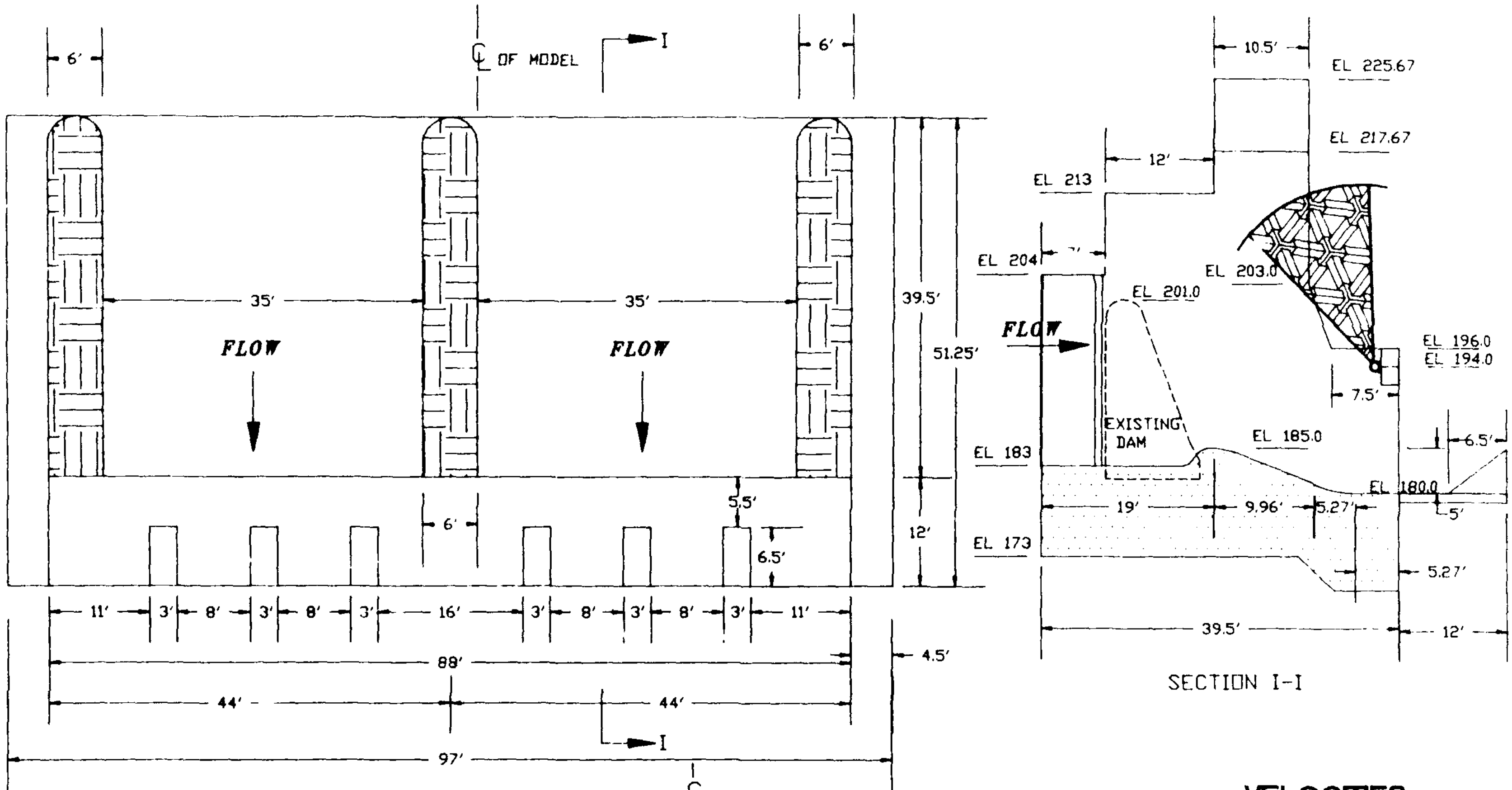

VELOCITIES
TYPE 6 DESIGN
ENERGY DISSIPATOR
DISCHARGE 38,500 CFS
POOL EL 206.5
TAILWATER EL 199.0
SECTION F-F
EL 225.67
EL 217.67
EL 213
EL 204
EL 203.0
EL 201.0
EL 196.0
EL 194.0
EL 185.0
EL 183
EL 180.0
EL 173
EXISTING DAM
FLOW
℄ OF MODEL
VELOCITIES
SURFACE 9.0 2.6 12.5 14.8 11.9 1.4 2.5
MID DEPTH 7.4 2.6 10.3 16.8 15.4 1.7 2.6
BOTTOM 7.3 2.9 11.3 15.7 11.9 4.2 3.8
STA 103+50
NOTE: VELOCITY STATIONS ARE 25 FT APART AND IN FEET PER SECOND
BOTTOM VELOCITIES 1 FT ABOVE FLOOR
NOT TO SCALE



VELOCITIES
TYPE 7 DESIGN
ENERGY DISSIPATOR
DISCHARGE 38,500 CFS
POOL EL 206.5
TAILWATER EL 199.0



VELOCITIES
TYPE 8 DESIGN
ENERGY DISSIPATOR
DISCHARGE 38,500 CFS
POOL EL 206.5
TAILWATER EL 199.0



VELOCITIES

℄ OF MODEL

SURFACE	12.6	10.3	1.8	13.3	12.2	10.0	3.3	7.6
MID DEPTH	13.3	8.1	1.8	10.5	18.8	14.8	1.2	1.3
BOTTOM	9.7	6.8	2.6	16.7	17.7	18.9	2.7	1.3

STA 103+50

NOTE: VELOCITY STATIONS ARE 25 FT APART AND IN FEET PER SECOND
BOTTOM VELOCITIES 1 FT ABOVE FLOOR

NOT TO SCALE

VELOCITIES
TYPE 9 DESIGN
ENERGY DISSIPATOR
DISCHARGE 38,500 CFS
POOL EL 206.5
TAILWATER EL 199.0

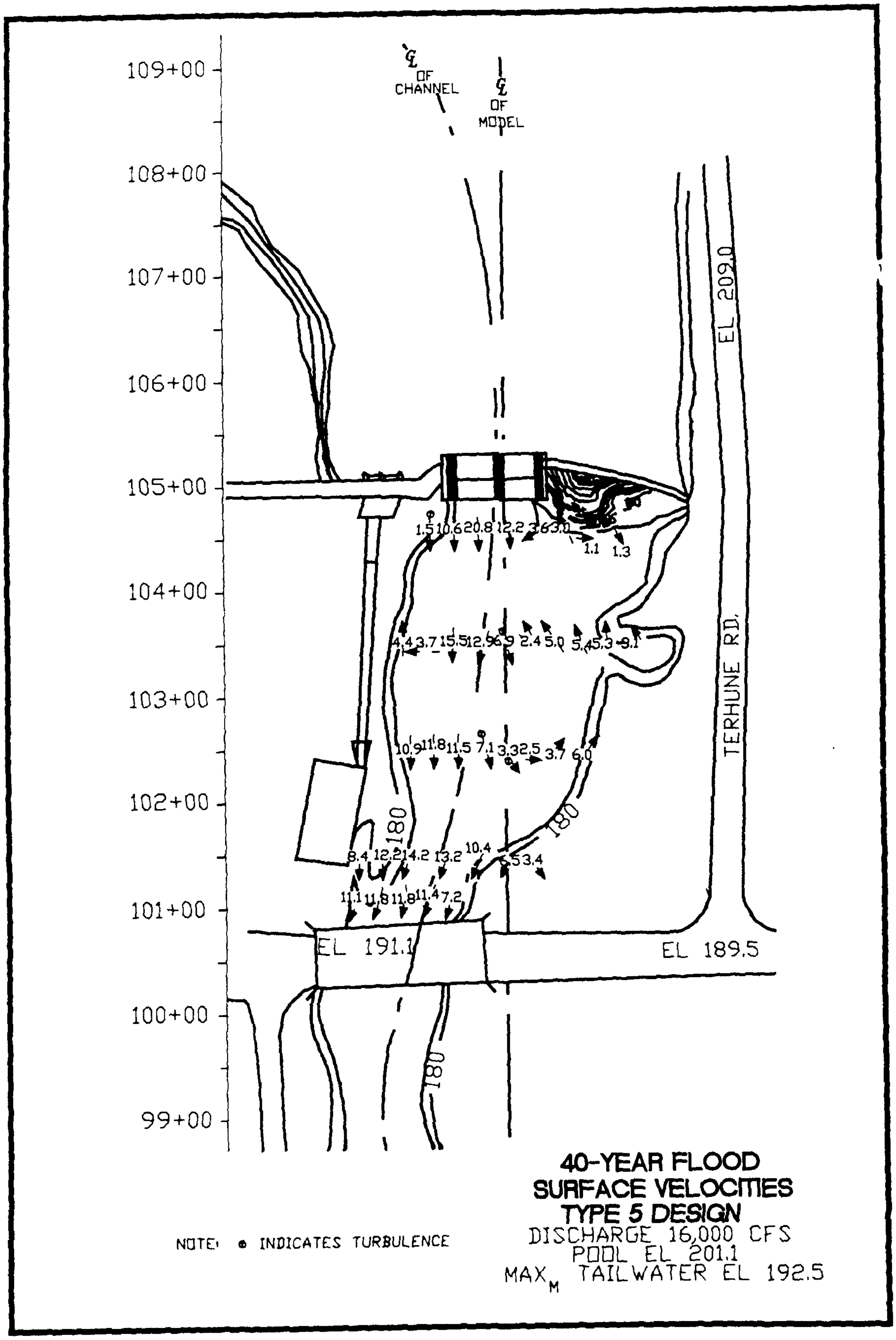
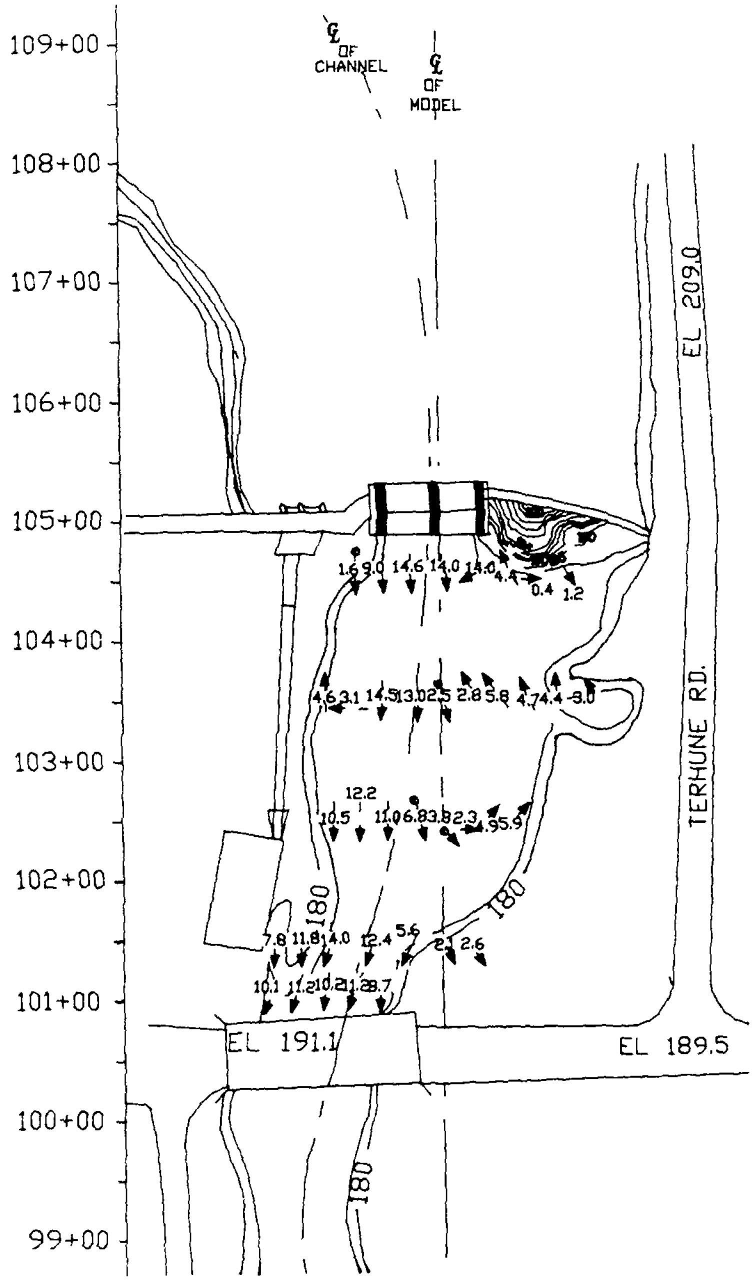


PLATE 48
(Sheet 1 of 3)



NOTE: ● INDICATES TURBULENCE

40-YEAR FLOOD
MIDDEPTH VELOCITIES
TYPE 5 DESIGN
DISCHARGE 16,000 CFS
POOL EL 201.1
MAX$_M$ TAILWATER EL 192.5

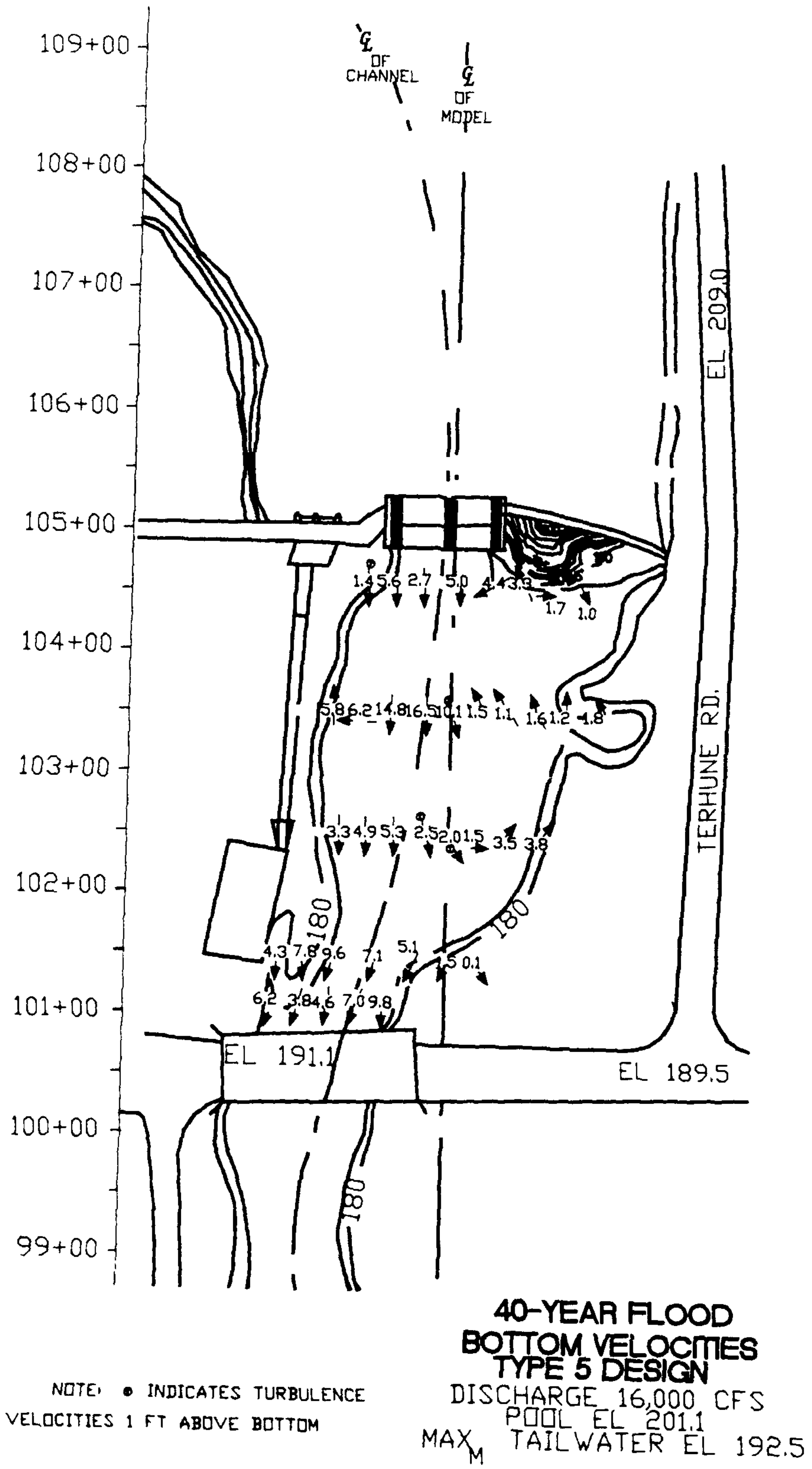
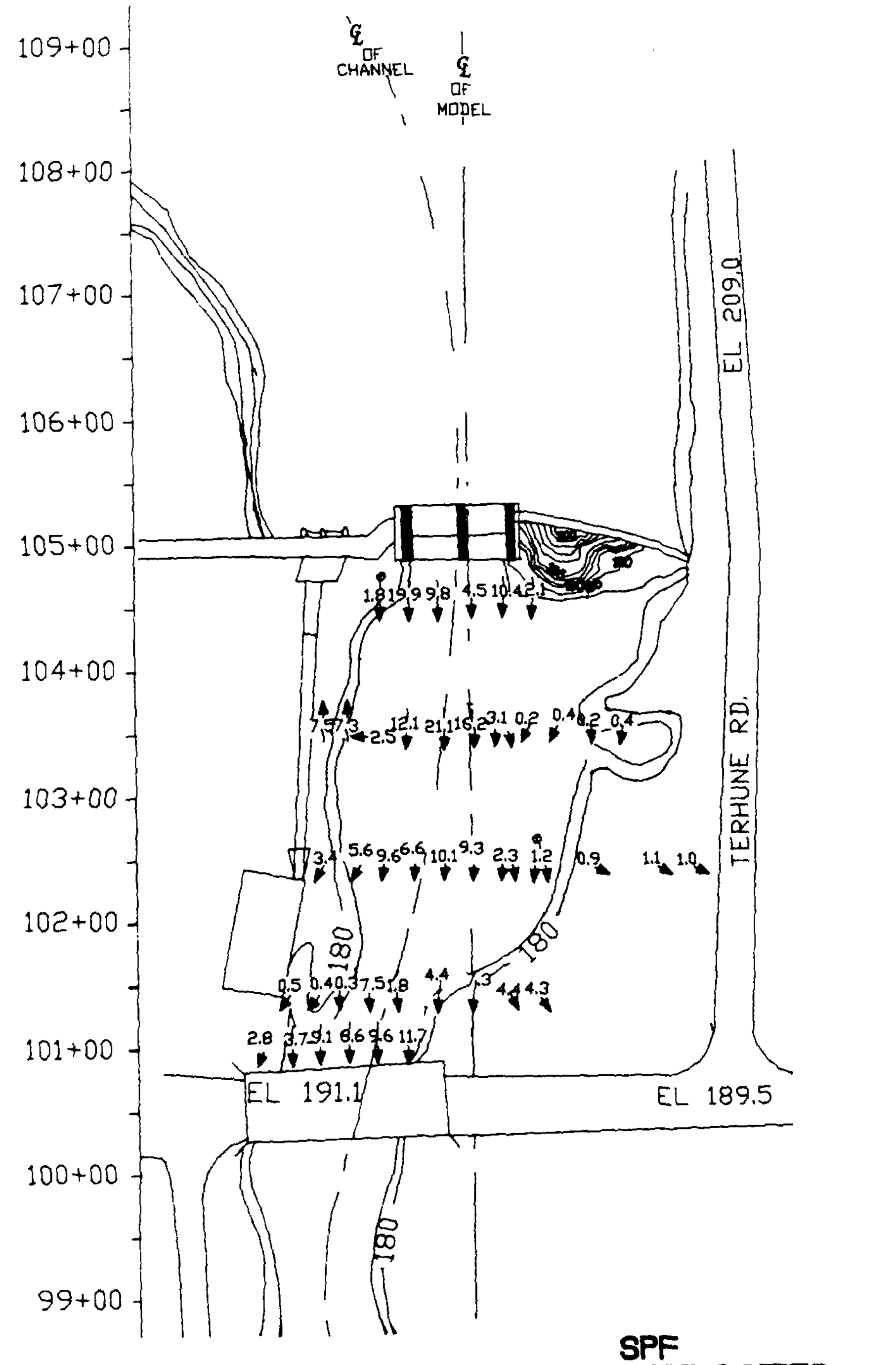


PLATE 48
(Sheet 3 of 3)



SPF
SURFACE VELOCITIES
TYPE 5 DESIGN
DISCHARGE 38,500 CFS
POOL EL 206.5
MAX$_{M}$ TAILWATER EL 199.0

NOTE: ● INDICATES TURBULENCE

PLATE 49
(Sheet 1 of 3)

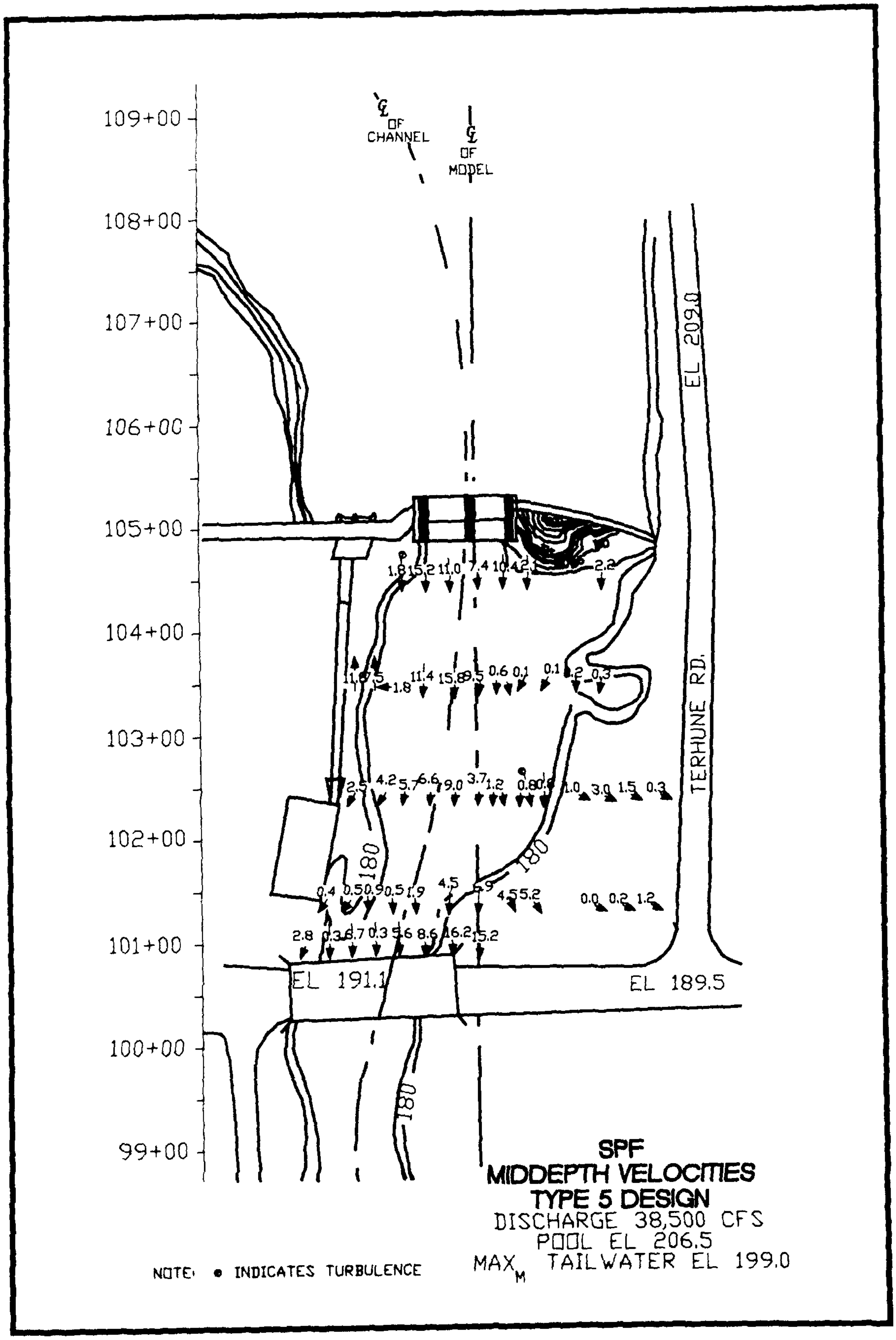


PLATE 49
(Sheet 2 of 3)

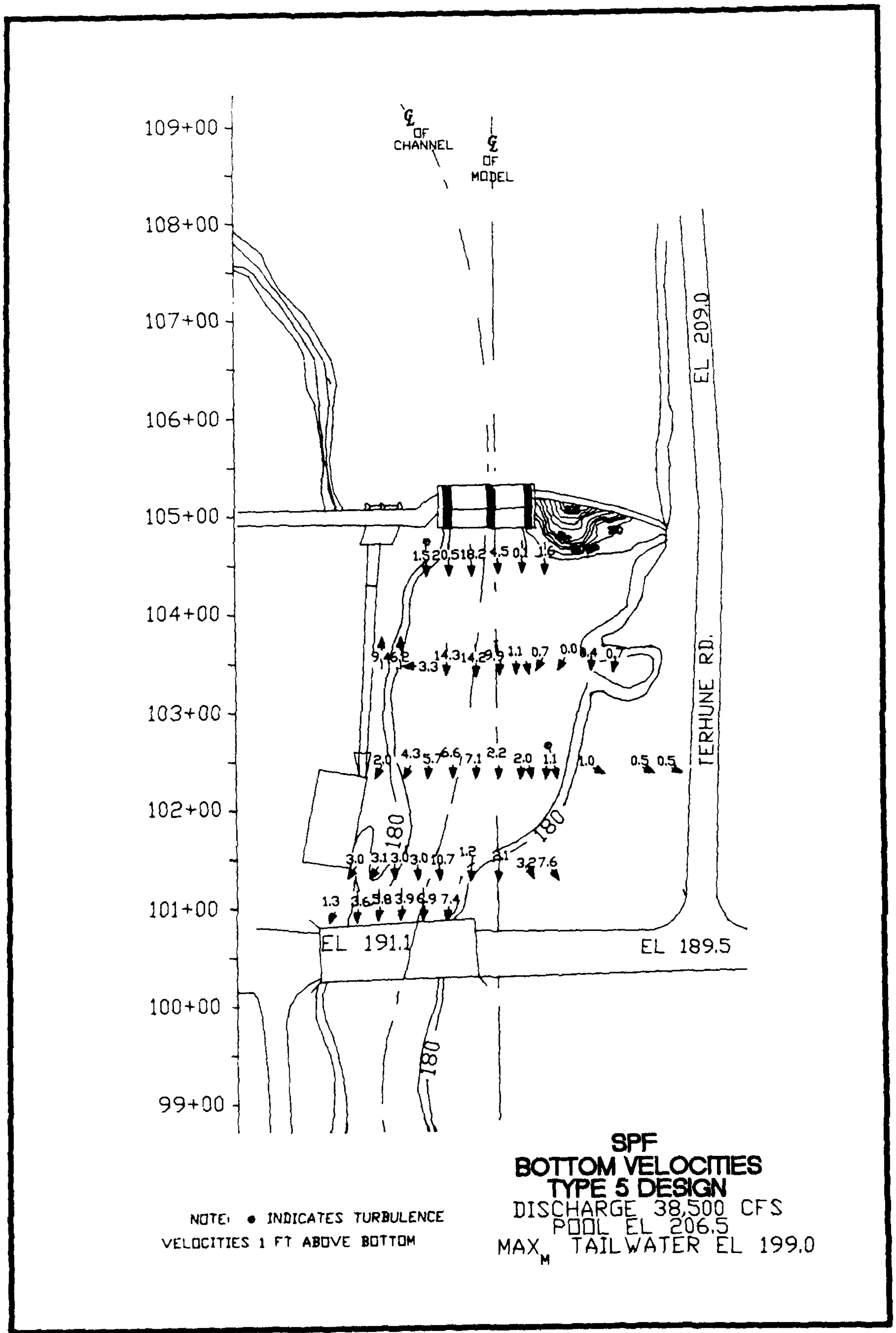
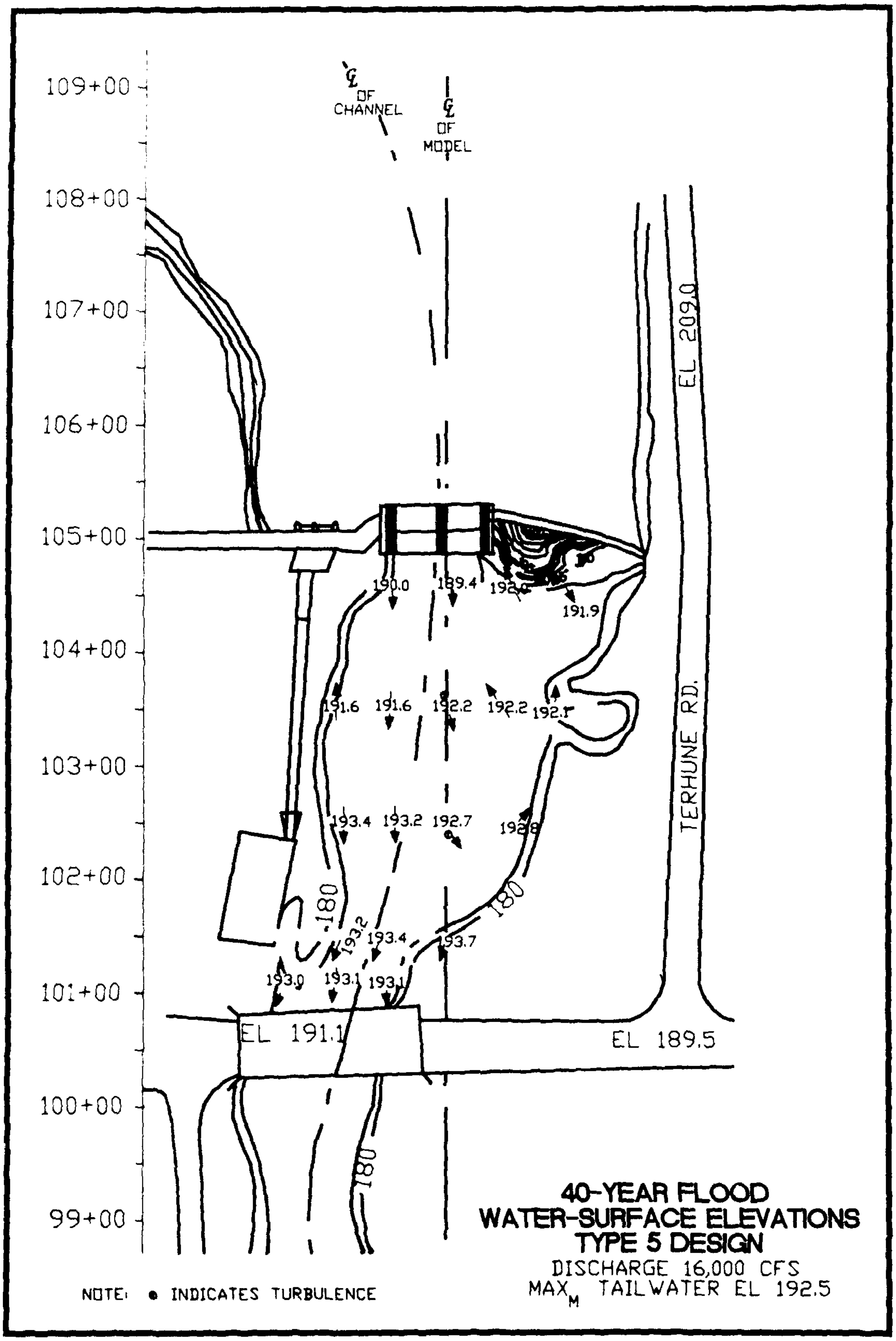
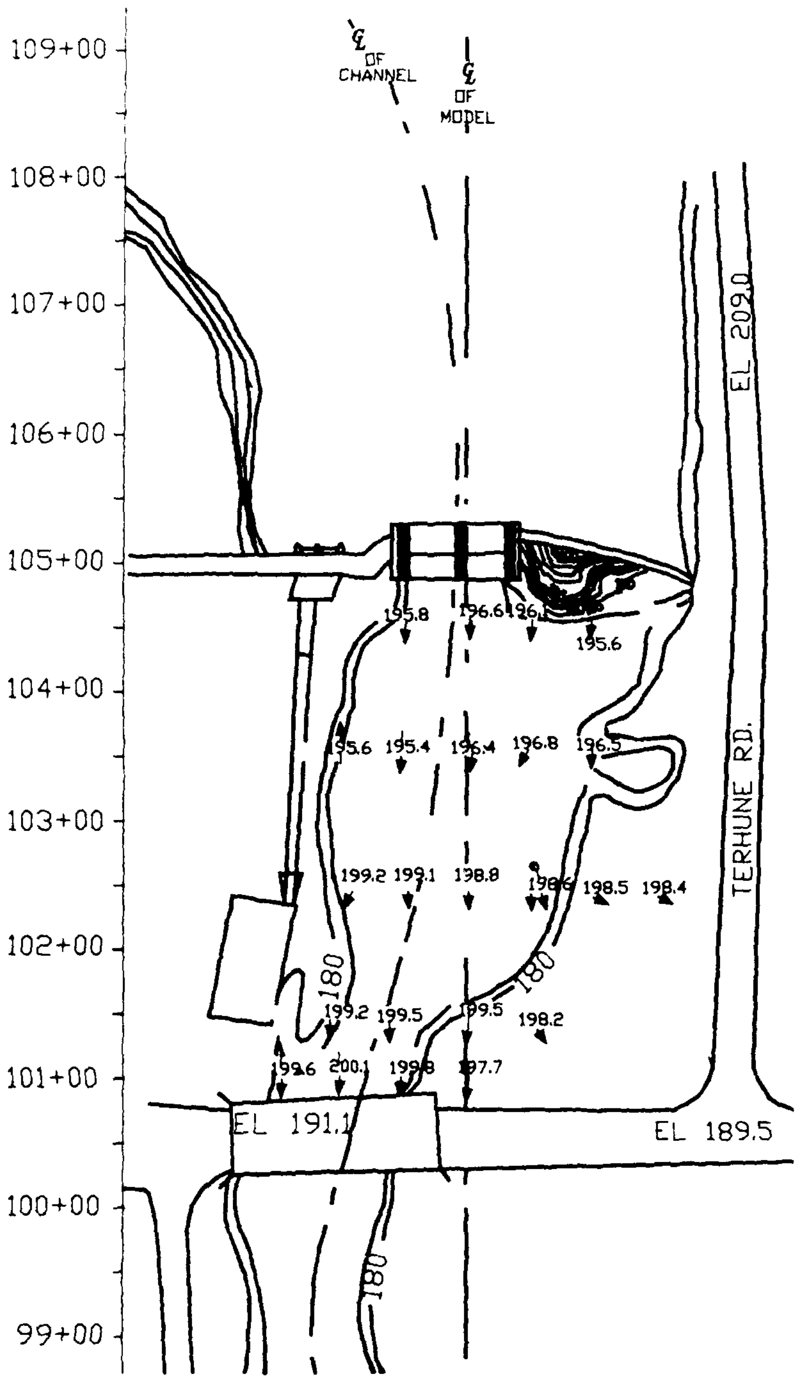


PLATE 49
(Sheet 3 of 3)



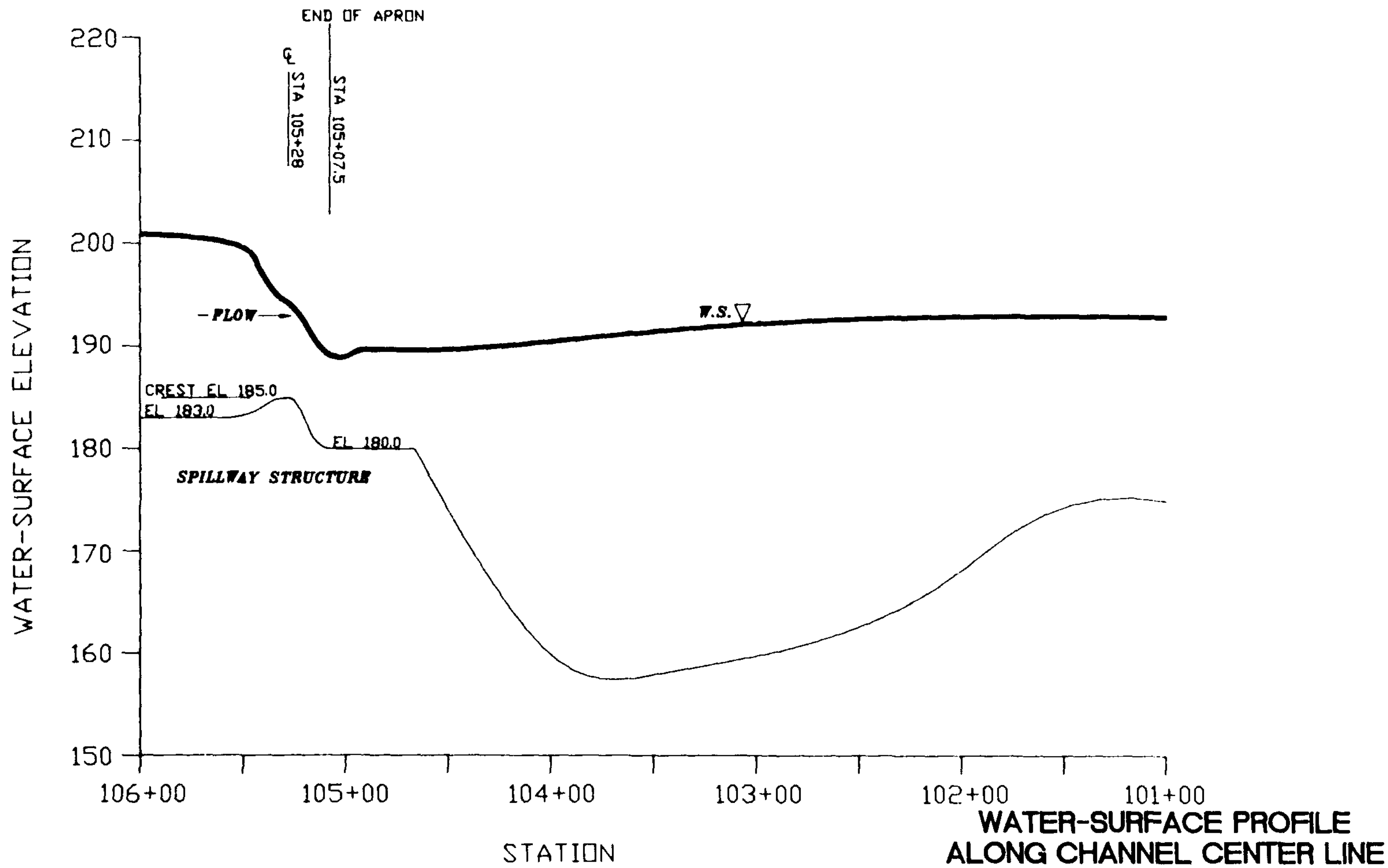
109+00
108+00
107+00
106+00
105+00
104+00
103+00
102+00
101+00
100+00
99+00
℄ OF CHANNEL
℄ OF MODEL
EL 209.0
TERHUNE RD.
190.0
189.4
192.0
191.9
191.6
191.6
192.2
192.2
192.1
193.4
193.2
192.7
192.8
180
193.2
193.4
193.7
193.0
193.1
193.1
EL 191.1
EL 189.5
180
40-YEAR FLOOD
WATER-SURFACE ELEVATIONS
TYPE 5 DESIGN
DISCHARGE 16,000 CFS
MAX M TAILWATER EL 192.5
NOTE: ● INDICATES TURBULENCE

PLATE 50



NOTE: ● INDICATES TURBULENCE

SPF
WATER-SURFACE ELEVATIONS
TYPE 5 DESIGN
DISCHARGE 38,500 CFS
MAX_M TAILWATER EL 199.0



WATER-SURFACE PROFILE
ALONG CHANNEL CENTER LINE

TYPE 5 DESIGN

DISCHARGE 16,000 CFS
POOL EL 201.1
MAX_M TAILWATER EL 192.5

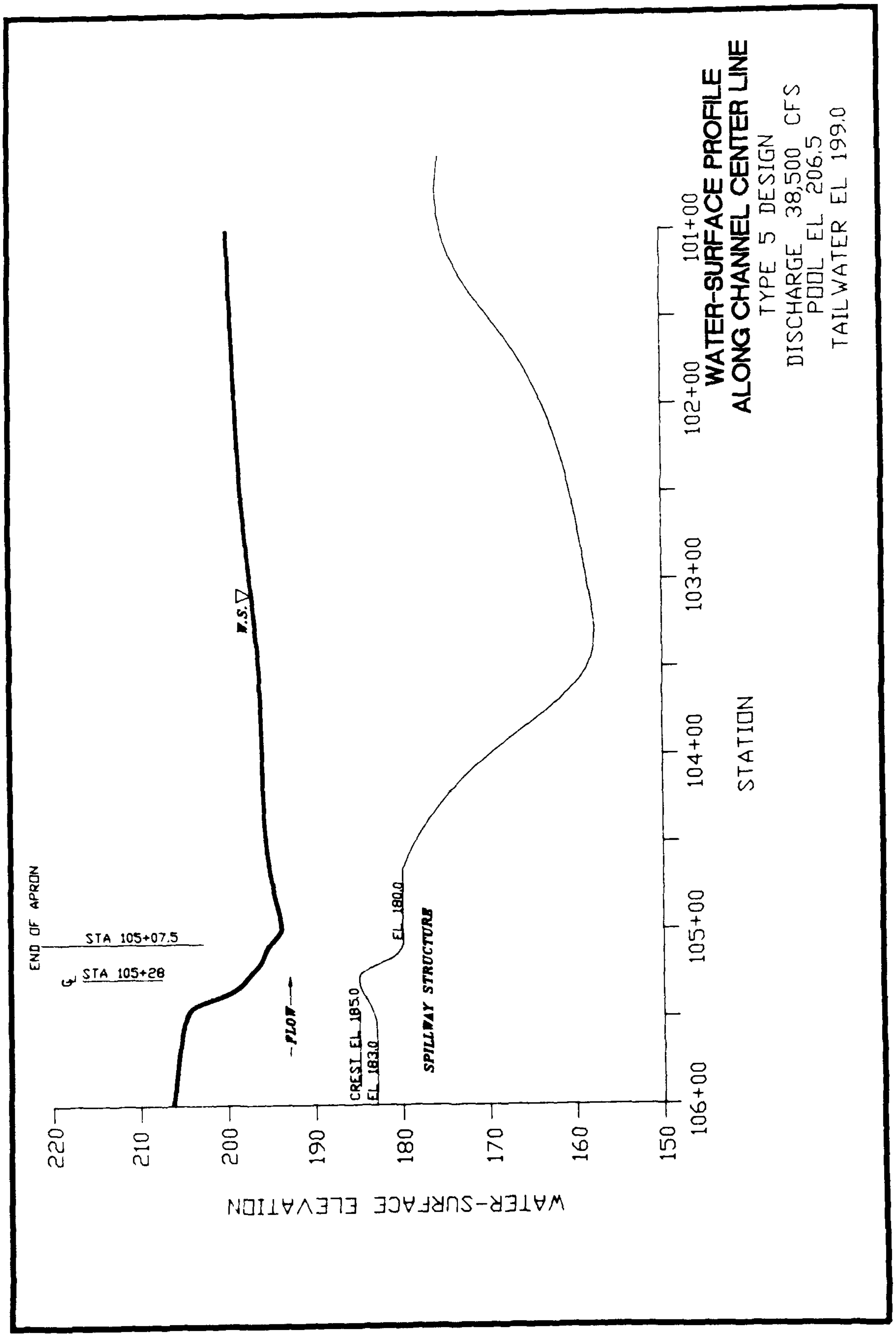
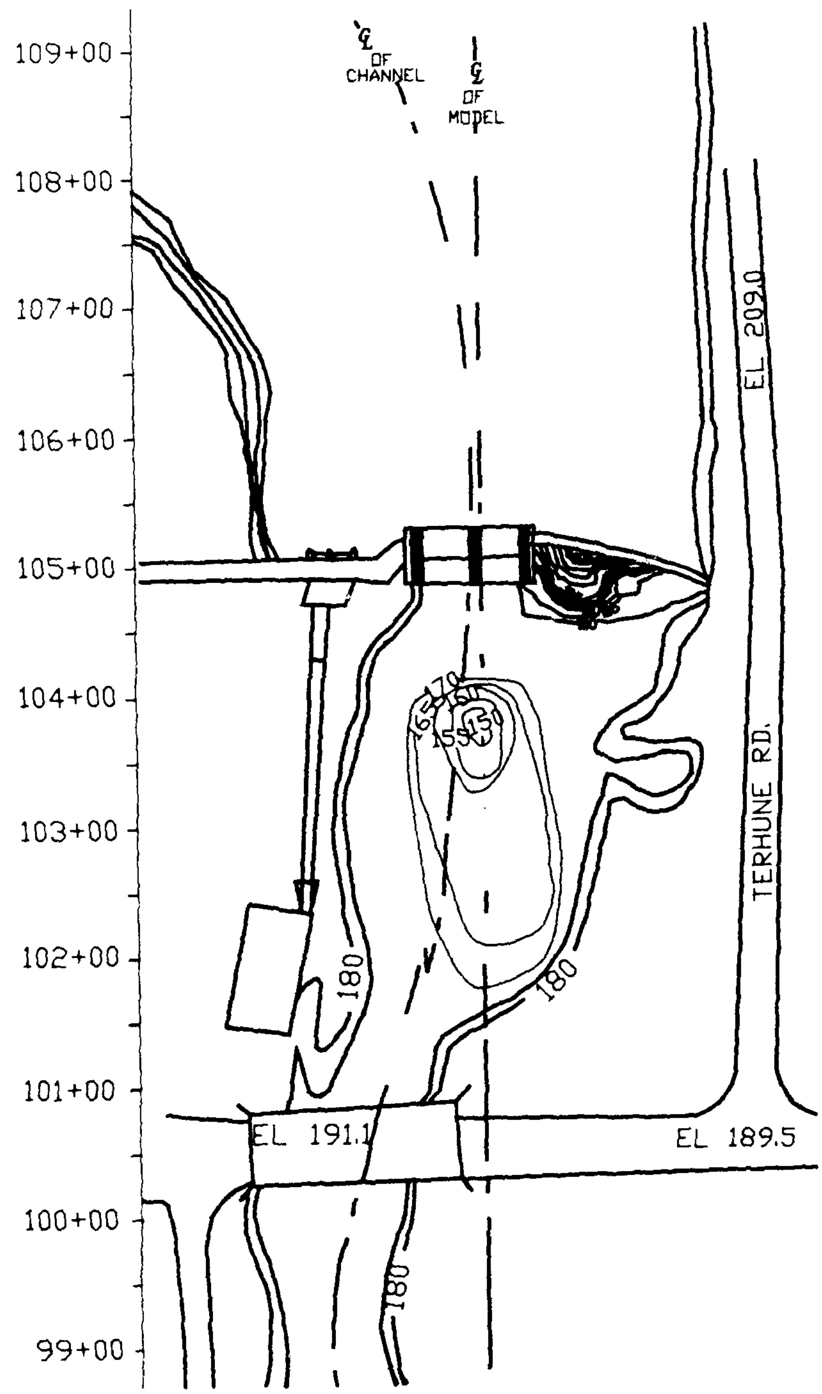
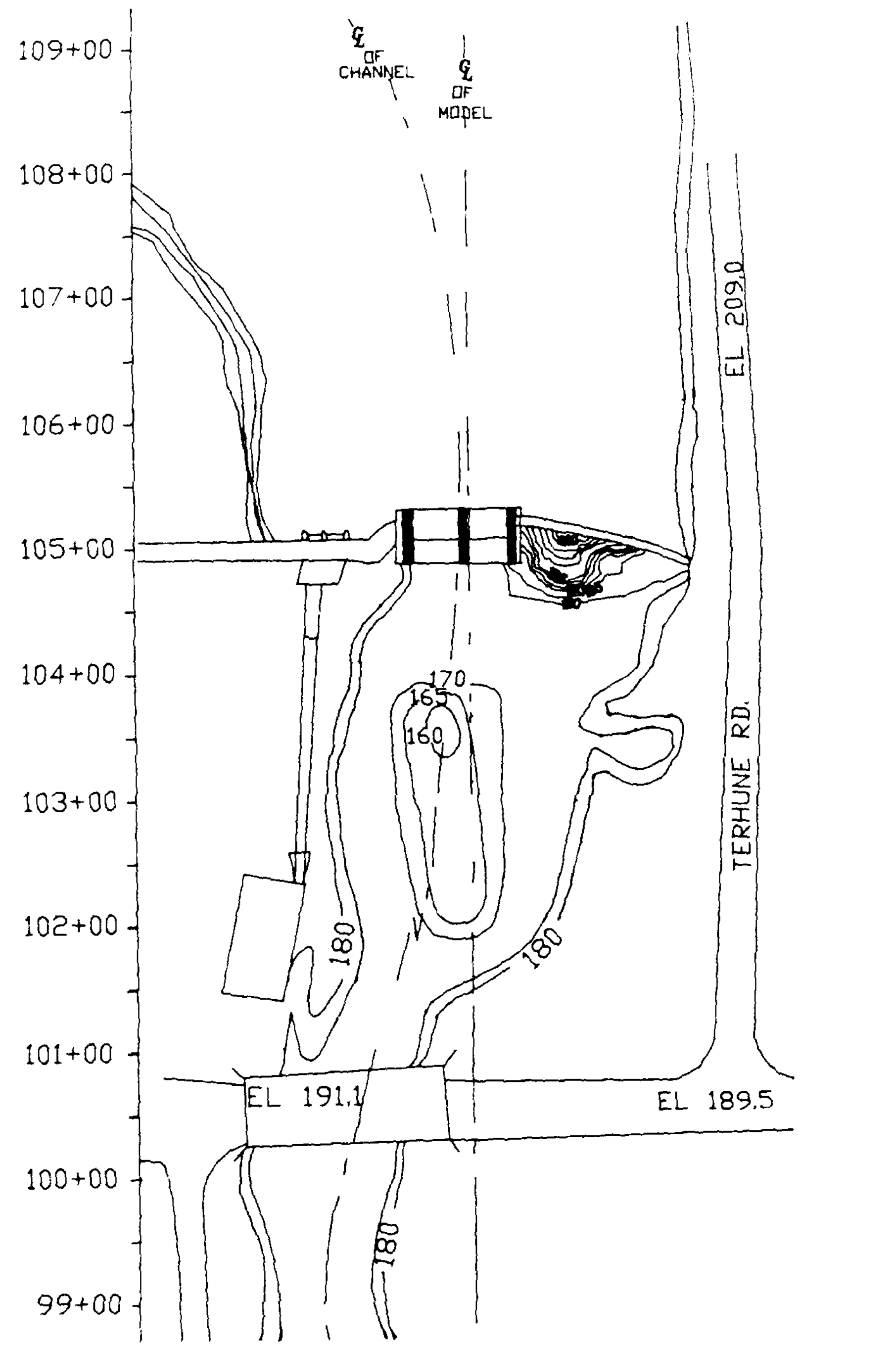


PLATE 52
(Sheet 2 of 2)



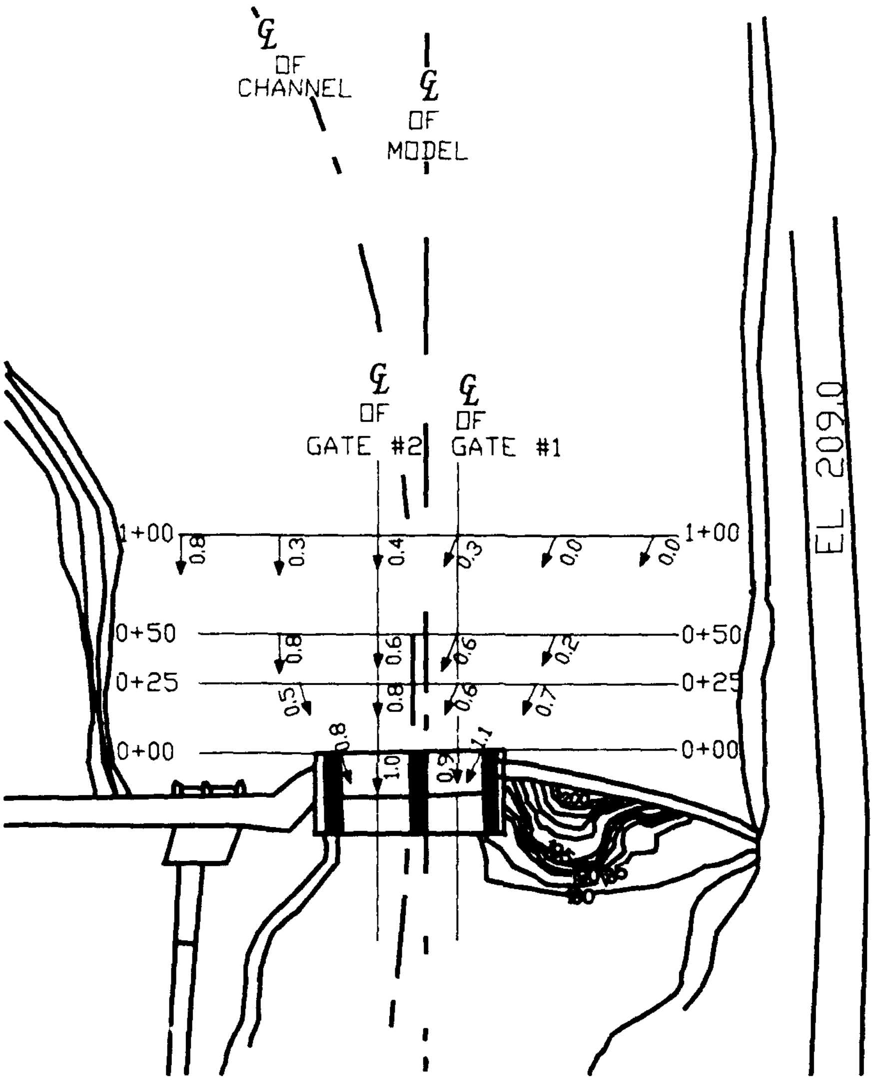
40-YEAR FLOOD
SCOUR CONTOURS
TYPE 5 DESIGN
DISCHARGE 16,000 CFS
POOL EL 201.1
TAILWATER EL 192.5

PLATE 53



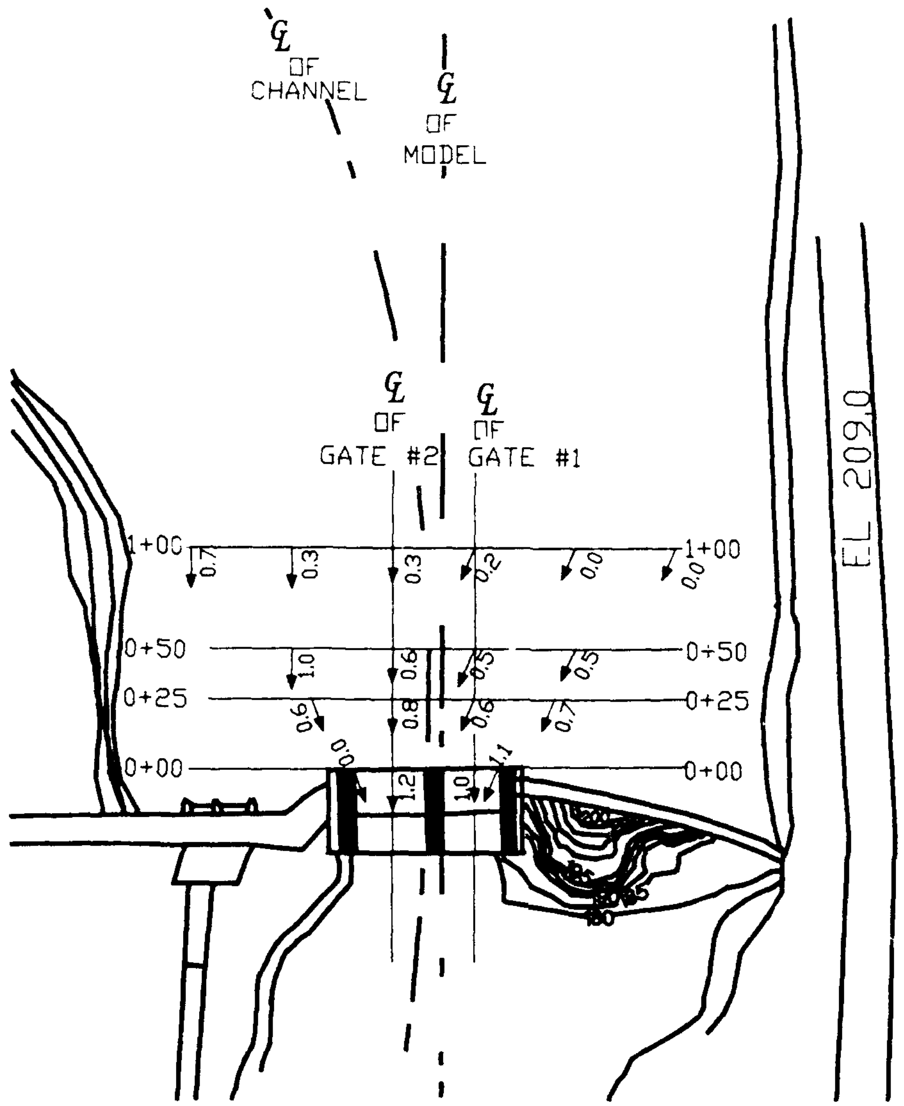
SPF
SCOUR CONTOURS
TYPE 5 DESIGN
DISCHARGE 38,500 CFS
POOL EL 206.5
TAILWATER EL 199.0

PLATE 54

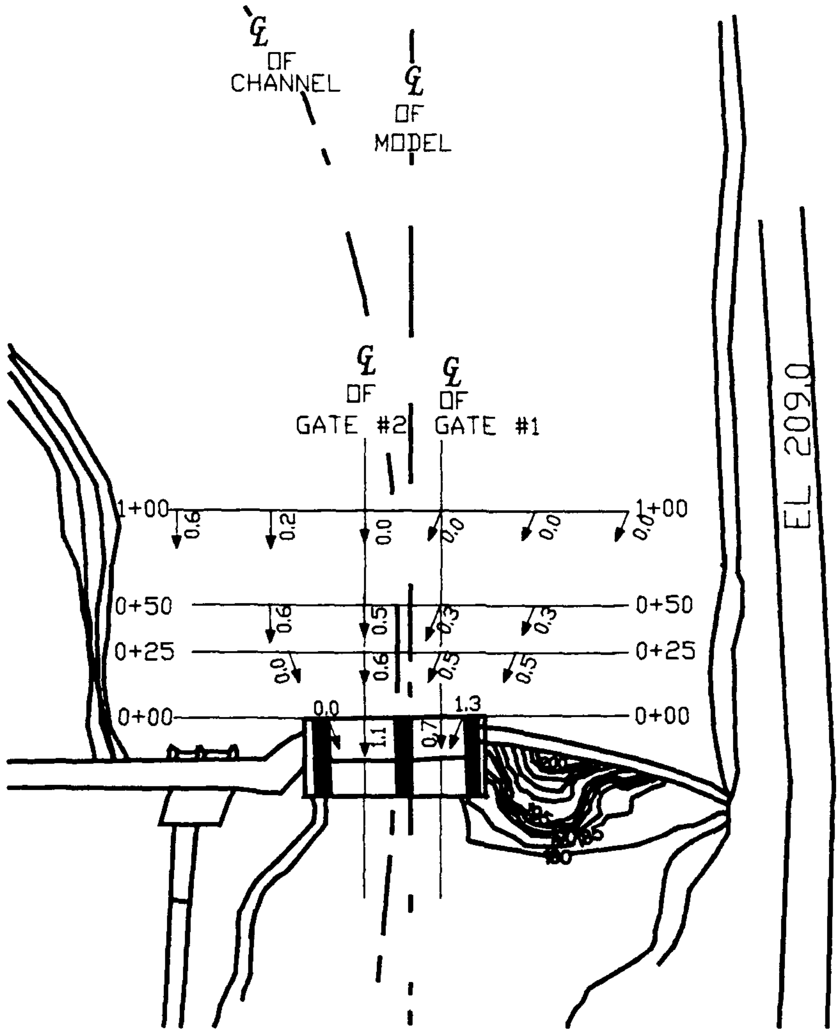


APPROACH FLOW SURFACE VELOCITIES TYPE 1 (ORIGINAL) DESIGN

DISCHARGE 3,100 CFS
POOL EL 201.5
Go=1.0 FT



APPROACH FLOW
MIDDEPTH VELOCITIES
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 3,100 CFS
POOL EL 201.5
Go=1.0 FT



NOTE: VELOCITIES 1 FT ABOVE FLOOR

APPROACH FLOW
BOTTOM VELOCITIES
TYPE 1 (ORIGINAL) DESIGN
DISCHARGE 3,100 CFS
POOL EL 201.5
Go=1.0 FT